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Field Demonstration of General Motors Environmental Improvement Proposal (EIP) A Retrofit Kit for GMC City Buses

Southwest Research Inst, San Antonio, Tex

Prepared for

Environmental Protection Agency, Ann Arbor, Mich Air Pollution Control

Jun 71

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Motor Vehicle Emission Lab
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FIELD DEMONSTRATION OF GENERAL MOTORS ENVIRONMENTAL IMPROVEMENT PROPOSAL (EIP) - A RETROFIT KIT FOR GMC CITY BUSES

by

Karl J. Springer

INTERIM REPORT

Contract No. PH 22-68-23

Long Range Investigation of Diesel Emissions

Prepared for

Environmental Protection Agency
Air Pollution Control Office
Willow Run Airport
Ypsilanti, Michigan

June 1971

ENVIRONMENTAL PROTECTION AGENCY

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Three GM city buses have been equipped with the GM Truck and Coach Environmental Improvement Proposal retrofit kit and operated approximately 25,000 miles. Noise tests were made before and after kit installation. With regard to odor, smoke, and other tailpipe emissions, the Low Sac Needle injectors were found to give consistently and substantially lower smoke, odor, HC, CO and oxygenates during this initial 25,000-mile test period. The catalytic muffler, one item included in the EIP kit, was found to be largely ineffective in reducing emissions. The vertical stack has the effect of making odor and noise less noticeable to the man-in-the street, but may make smoke more visible. These findings are in agreement with component studies conducted during the past 3 years with the catalytic muffler and improved injectors.

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Approved:

for John M. Clark, Jr., Director
Department of Automotive Research

FOREWORD

This project was an outgrowth of Southwest Research Institute Proposal 11-7289, dated May 4, 1970, provided at the request of the Air Pollution Control Office (APCO) of the Environmental Protection Agency (EPA). A joint meeting with officials from the Department of Transportation (DOT), Urban Mass Transportations Administration (UMTA), APCO, and representatives of San Antonio Transit System, General Motors Truck and Coach Division, and Southwest Research Institute was held at SwRI on April 29, 1970. The purpose of the meeting was to discuss the Environmental Improvement Proposal (EIP) made by GM Truck and Coach Division in December 1969 to DOT's UMTA. As a result of this meeting, a proposal for field demonstration and testing was prepared and subsequently accepted. Modification 9 was issued to the basic contract for the Long-Range Investigation of Diesel Exhaust Emissions on July 1, 1970, authorizing the start of the extended fleet test. Modification 11 was received on April 16, 1971, authorizing continuation of the test to the originally planned 2-year test duration. Work began in July 1970, and the entire test is scheduled for completion in January 1973. The EPA Project Officer in charge of this demonstration is Mr. Ralph Stahman, Test and Evaluation Branch, Division of Emission Control Technology, Environmental Protection Agency, Air Pollution Control Office, Willow Run Airport, Ypsilanti, Michigan, and the SwRI Project Director is Mr. Karl J. Springer. The project is identified by SwRI as 11-2340-04.

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I. INTRODUCTION

The emissions from diesel-powered vehicles, notably odor and smoke, have been the subject of industry and government research for a number of years. The municipal bus, widely used for urban mass transportation, has received the brunt of public objectionability mainly due to the odorous exhaust gases emitted by certain vehicles under certain operating conditions. Diesel exhaust emissions comprise more than smoke and odor, though these are the most widely known pollutants from this class of engine. Hydrocarbons and carbon monoxide, chief pollutants from gasoline-fueled passenger car engines, are substantially less from the diesel engine and only nitric oxide keeps the diesel from being considered a "clean" engine.

Though the odor itself has not been positively found a health hazard, it does, like smoke, qualify as a nuisance emission as it is an annoyance and thereby affects public welfare. A considerable amount of research has been reported on the emissions from diesel engines. A recent study of ways to reduce diesel odor and smoke (Ref. 1) contained over 300 references, many of which were related to city bus emissions.

On the order of 90 percent of the city buses operated in the U.S. today were made by GM Truck and Coach Division and are powered by 6-cylinder (inline and Vee configuration) and 8-cylinder (Vee configuration), 2-stroke, 71 series (71-cu. in. displacement per cylinder) engines made by the Detroit Diesel Division of General Motors Corporation (GMC). For the past five years, the majority of the work on odor for EPA's APCO, formerly the National Air Pollution Control Administration of the Department of Health, Education, and Welfare, has been devoted to the city bus odor problem. Parts I, II, III, and IV (Ref. 2-5) of the Long-Range Investigation of Diesel Powered Vehicle Exhaust Emissions, of which this field demonstration is a part (see Foreword), and studies of public objectionability of Diesel Odor (Refs. 6 and 7) describe the activities by SwRI's Vehicle Emissions Research Laboratory on behalf of the APCO. These studies covered the three important aspects of diesel odor, namely (1) a method of measurement and expression, (2) evaluation of control technology, and (3) an assessment of public reaction to diesel odors.

As mentioned in the Foreword, a 2-year, 3-bus field demonstration of the General Motors Truck and Coach Division's Environmental Improvement Proposal (EIP kit) was authorized by APCO in July 1970. The kit is claimed by GMC to reduce emissions, noise, and vibration. The cost as of December 22, 1969, for the entire EIP kit was reported as $1100 for 6V-71 size and $1200 for 8V-71 size engine-powered GM coaches.

The three items featured as reducing emissions are a vertical stack, a catalytic muffler, and improved needle valve unit injectors known as Low

Sac Needle or LSN injectors. The kit is composed of items, most of which were tested during Parts I, II, III, and IV of this long-range investigation, for which the relative merits and effectiveness of each major feature had been reported. This included studies of exhaust dilution due to stack placement, effect of catalytic mufflers, improved injectors, fuel type, etc.

During the April 1970 meeting at SwRI (referenced in the Foreword), the merits of each major item were discussed and the component test results cited. It was pointed out that, although not reducing the amount of odor discharged, the vertical stack may be a useful method to disperse the exhaust and thereby render the odor less noticeable to the general public. Though Part I data indicated a sevenfold increase in reasonable minimum atmospheric dilution (from 100:1 to 700:1) for the use of tall vertical stack relative to a low-to-the-ground horizontal discharge, little is known about the atmospheric dilution of the exhaust from a stack located behind a bus. The previous tracer-gas studies employed a tractor-box type trailer rig in which the stack was in front of the 40-ft-long van trailer.

A paper presented by GM Research at the January 1971 meeting of the SAE (Ref. 8) described the results of dilution experiments made with a vertical stack-equipped city bus. It is unfortunate that only the engine-idle, static vehicle condition was studied and that the vertical stack was not identical to that fabricated as part of the EIP kit. For the one condition studied, GMR found essentially an eightfold increase in dilution by directing the exhaust vertically instead of horizontally.

In addition, it was pointed out at this meeting that, during Part II, GM Truck and Coach furnished several "cornpopper" type catalytic mufflers for test and evaluation. Repeated screening tests, made after limited (1 month) street operation, indicated little positive reduction on odor or other emissions. This same muffler is currently proposed in the EIP project. It is a Davidson Chemical Catalyst Zone 61 copper oxide material deposited on the surface of nominal 1/4-in.-diameter alumina balls.

Screening tests (Part II) and a 6-month fleet test of three city buses consistently showed significant reductions in odor, smoke, and other emissions from the use of correctly adjusted needle (LSN) injectors. Though there seems to be a difference of opinion concerning the effect of the injectors on NO production, the known advantages and disadvantages of each component were fully reported and discussed. At the urging of UMTA, however, it was agreed to perform an extended, 2-year fleet test of the comprehensive retrofit kit in three buses. These tests were requested to verify the claims by the kit manufacturer as to improvements in noise, odor, smoke, and other gaseous-type emissions. The tests were to be designed to determine overall kit performance as well as relative improvement by the catalytic muffler.

II. TEST PREPARATIONS

This section includes the test objective, description of the vehicles and EIP kit, installation and adjustments, and the test plan-procedures employed.

A. Objective

The object of this test is to determine potentialities of the GM EIP, retrofit kit for reduction of noise, odor, smoke, and tailpipe emissions from three GM city buses powered by Detroit Diesel 6V-71E buses.

B. Approach

To ascertain performance improvements and reduction of emissions, liberal use of back-to-back type tests were employed to permit direct comparison of the EIP-equipped bus versus the stock-equipped vehicle with an additional series of tests of the EIP kit less the catalytic muffler. Noise tests were made in the normal configuration before installation of the kits and immediately after kit installation. The initial emission measurements were made after about 1000 miles of operation by substituting for the EIP catalytic muffler a stock unit and for the LSN injectors 5 or crown valve-type stock injectors. Emission inspections were then made at four points during the test, after approximately 20,000-mile increments. Specifically excluded was the effect of the vertical stack on dilution and vibration-ride measurements. The effect of fuel, i.e., DF-1 or DF-2, on exhaust emissions remains to be studied.

C. Vehicle and EIP Kit Description

The three vehicles selected were from the San Antonio Transit System fleet of GM Truck and Coach Divison 45-passenger coaches. The specific vehicles were all TDH-4519 models powered by similar Detroit Diesel 6V-71E 2-valve engines equipped with size 60 type 5 injectors. The three buses, described in more detail in Appendix A, recently received engine overhauls. It was desired, for purposes of the test, to have three vehicles and engines that could reasonably be expected to run for two years at a high rate of mileage accumulation without engine failure.

The EIP kit has been adequately described in Reference 9 and a revised proposal published in April 1970 (Ref. 10). In addition to a different set of injectors, muffler, and a vertical exhaust stack, a vertical air inlet, enlarged air cleaner, engine mounts, sheet metal fairings, housings, etc., were included. For a complete description of the kit, please refer to References 9 or 10. Some key items of the EIP kit deserve special mention. The catalytic muffler, described by a GM Coach Service bulletin, is shown in Figure 1 with inspection fill plug removed. The unit is in the same horizontal position as when installed

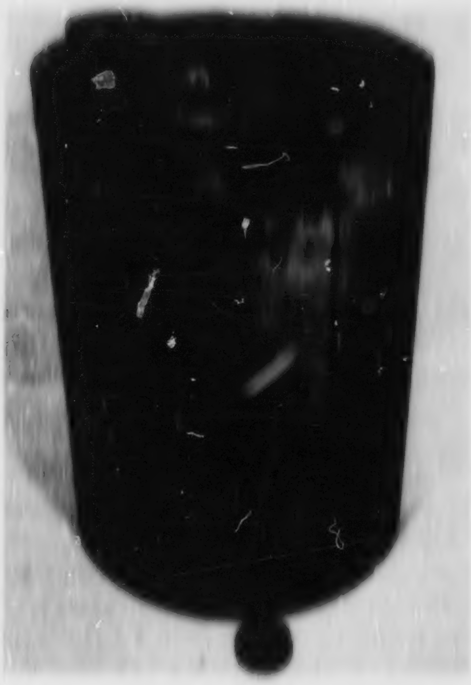

FIGURE 1. CATALYTIC MUFFLER
(Horizontal Position)

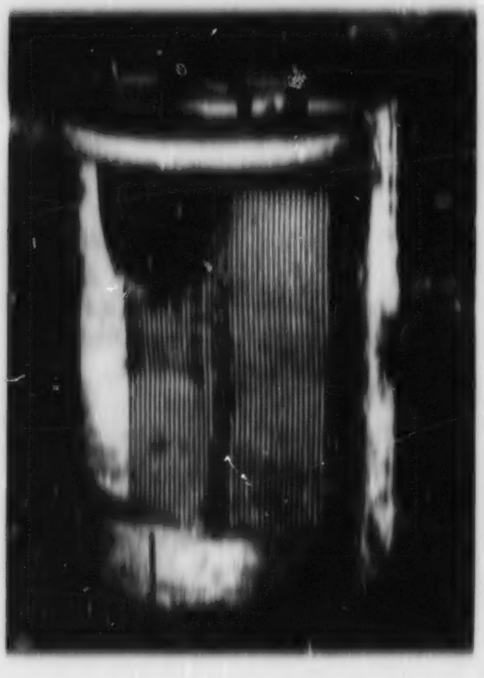

FIGURE 2. CUTAWAY OF CATALYTIC MUFFLER
(Photo Furnished by GMC)

under the coach. Figure 2 is a cutaway of the muffler and shows the perforated metal screen on which the 40-lb charge of catalyst-coated alumina balls is carried.

Figure 3 is a view of a LSN injector after a short period of operation. Externally, it appears basically the same as the crown valve unit but internally it is different. Figure 4 is a cutaway showing the plunger and barrel and the injector tip. It is the injector tip, which incorporates an improved needle-type valve, that reduces the residual fuel in the injector tip as shown schematically in Figure 5. It is this residual fuel leaking into the combustion chamber at odd moments during the cycle that has been found responsible for some of the odor, smoke, and other exhaust emissions.

D. Test Fuel

A commercial DF-1 (No. 1) kerosene-type diesel fuel was utilized in all tests reported in this interim report. This fuel is described by the inspection report of Table 1.

E. Installation

Three complete EIP kits were furnished to San Antonio Transit System at no charge by the manufacturer, the Truck and Coach Division of General Motors Corporation. In addition, expert guidance in the installation of the kits was provided by the manufacturer during the actual installation and retrofit phase. An engineer and two experienced technicians did an excellent job of not only supervising and installing the kits on the first two buses, but also training the San Antonio Transit staff so that they could efficiently and correctly apply the retrofit items to the last bus modified.

It was found that, for a well-trained crew using up-to-date and first-rate facilities and equipment, a normal installation will take slightly less than the 160 hr originally estimated by GM. We found that on Bus 702, the last bus converted, the direct mechanic time was more like 150 hr, exclusive of any engineering supervision, i.e., no problems encountered. This level of effort was discussed with the manufacturer's representative, and it was agreed that 150 hr was a reasonable figure.

One area of importance during the installation phase was that of engine and transmission adjustment. The 1970 engine certification for smoke is specified at 1.460 injector setting by Detroit Diesel Division. However, the coach manufacturer indicates 1.470 to be the optimum for lowest overall emissions. Since this is an experiment with used buses, the EIP recommendation of 1.470 was used to adjust the injectors on these pre-1970 engines. However, this item of injector adjustment and smoke certification versus engine-emissions compatibility has yet to be resolved.

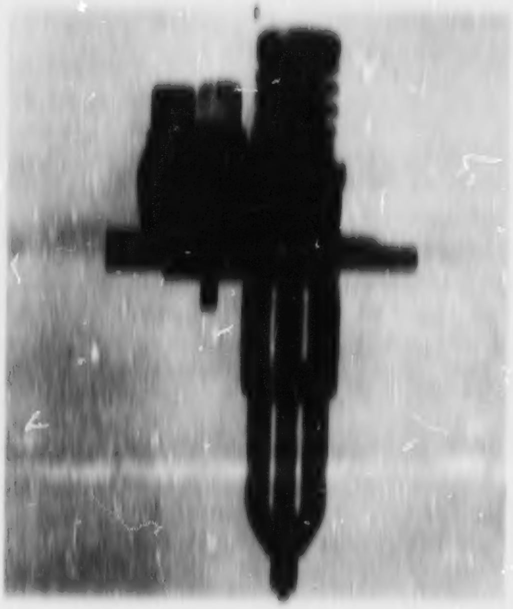

FIGURE 3. L8N UNIT INJECTOR**

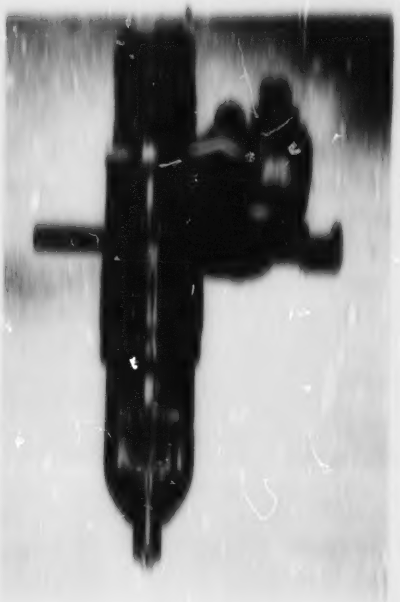

FIGURE 4. CUTAWAY OF
L8N UNIT INJECTOR
(Photo Furnished by GMC)

STANDARD INJECTOR
NEEDLE VALVE

FIGURE 5. SCHEMATIC OF CROWN (STANDARD)
AND NEEDLE VALVE INJECTOR TIPS
(Photo Furnished by GMC)

TABLE I. FUEL INSPECTION DATA--TYPICAL SPECIFICATIONS

Commercial Fuel Type	DF-1
Sample Information Code	EM-165-F
Date Analyzed	10-10-70
Property	
Distillation Range	
Initial Boiling Point, °F	336
10% Point, °F	360
20%	372
30%	380
40%	388
50%	396
60%	404
70%	414
80%	428
90%	450
End Point	489
% Recovery	98.0
% Residue	1.8
% Distillation Loss	0.2
Cetane Number	45.8
FIA Analysis	
Aromatics, %	15.2
Olefins, %	2.5
Saturates, %	82.3
Total Sulfur, %	0.08
Gravity, °API at 60°F	44.7

The other adjustment, critical to the EIP kit, is raising the engine upshift and downshift speeds. As these shift points dictate the way a bus operates and, to some extent, the route speed and passenger comfort, adjustments which materially alter these settings arrived at by years of trial-and-error experience by bus operators must be carefully considered. In essence, the original recommendations in the EIP brochure (Ref. 9) were incomplete and vague. Instructions from the manufacturer were obtained specifying the desired upshift and downshift engine speeds. The upshift engine speed, the speed of the engine immediately *after* shift from torque converter to direct drive, was specified at 1100 rpm minimum. The downshift speed, the most critical for the standpoint of exhaust emissions per previous SwRI data, was specified at 300 rpm below the upshift speed.

Considerable difficulty was encountered in setting these speeds by the San Antonio Transit System. The GM maintenance manual was found to be inadequate to set the upshift point, although downshift could be fairly reliably set by the recommended bench technique. The electromechanical transmission governors used on the older buses are quite nonrepeatable and unreliable and difficult to set accurately. SwRI finally had to set the shift points on all buses using a chassis dynamometer and a level road course. Final adjusted shift points were 1125 rpm up (25 to 26 mph) and 825 rpm (18 to 19 mph) down, for the 4-5/7 rear-axle ratio S.A.T. buses. This upshift speed is about 1 to 2 mph higher than before adjustment and represents an increase in engine speed of about 100 rpm after upshift. The maximum rpm the engine operated in torque converter, low range, before upshift was increased as much as 200 rpm so that the engine now reaches 1800 to 1900 rpm before the upshift occurs. This is where high exterior and interior sound levels have been noticed. The downshift speed is also higher than before, about 150 rpm (3 to 4 mph).

Though the transmission shift points were finally set and verified in the field, this is one area that could bear additional attention should widespread retrofit be justified. An improved transmission governor that can be easily and reliably bench adjusted using simple calibration procedure and equipment seems mandatory to realize the benefits of this proposal. A revised chart indicating governor rpm for desired engine rpm for the various rear-axle ratios and tire sizes will also be necessary. It is always good practice to field test one unit of many, but every bus should not have to be field adjusted, as was our experience. Should 100-percent field adjustment become necessary, an additional 8 to 12 man-hours per bus should be allocated for installation of the kit.

Figures 6 through 9 are various exterior views showing the location and extent of sheet metal cowlings housing the vertical air inlet (right rear) and the vertical exhaust stack (left rear). A simple flapper valve may be noticed on the tip of the exhaust stack in Figure 9. Figures 10 and 11 are snapshots of

FIGURE 6. EIP EQUIPPED COACH
(Rear View)

FIGURE 7. EIP EQUIPPED COACH
AIR INTAKE

FIGURE 8. EIP EQUIPPED COACH
VERTICAL EXHAUST LOCATION

FIGURE 9. EIP EQUIPPED COACH
EXHAUST OUTLET

FIGURE 10. EIP EQUIPPED COACH
EXHAUST EDUCTOR

FIGURE 11. EIP EQUIPPED COACH
ENLARGED AIR CLEANER

the engine compartment. The new exhaust piping for the vertical stack is evident in Figure 10, and the enlarged air cleaner-inlet air duct and blower inlet housing may be noticed in Figure 11.

F. Test Procedures

This subsection will describe the modifications made to procedures previously developed and described for odor, smoke, and gaseous emissions measurements. The measurement procedures used for the noise tests will be covered in Section III dealing with noise tests results. The PHS odor kit (Ref. 1), in Figure 12, and smokemeter (Refs. 3, 4, or 5), in Figure 13, was the basis for expression of odor and smoke results.

Odor was measured using the trained SwRI odor panel, Figure 14, using the PHS kit of standards. The panel rated the odor in terms of an overall intensity "D" in steps of 1 through 12, 12 being the strongest. Four subodors, or qualities, that comprise the "D" odor are "B" burnt smoky, "O" oily, "A" aromatic, and "P" pungent, in steps of 1 through 4. The odor measurement facilities, dynamometer, etc., have been adequately described in References 2, 3, 4, and 5. Any of these will suffice in illustrating the principle and approach used. The specific odor measurement and chassis dynamometer operating procedures are contained in Appendix A of Reference 5. All odor tests were made at a dilution level of 100:1.

Smoke was measured using a chassis dynamometer version of the Federal stationary engine procedure given in the June 4, 1968, Federal Register (Ref. 12). The bus was operated on a simulated Federal Smoke Test cycle including the two accelerations and the lugdown. For these tests, a single 16,000-lb equivalent inertia wheel, shown in Figure 15, was sufficient to give very close to the federally-prescribed acceleration times for the stationary operated engine. No difficulty was encountered in performing the engine lugdown procedure in a linear-rpm manner. The first acceleration was from 750 to 1800 rpm in 8 sec, the second from 1260 to 1900 rpm in 14 sec, and the lugdown from 1900 to 1260 rpm in a nominal 15 sec. The time would vary slightly from bus to bus, but repeatability of the smoke test for a given bus was found to be excellent. A power curve from 2000 to 1000 rpm in 200-rpm increments was also made with smoke recorded simultaneously. As the engine speed decreased below 1200 rpm, the tendency of the engine to smoke greatly increased with two to three times the smoke at 1260 rpm and above being common. The Federal smoke test procedure is considered suitable for engines operating in GM city coaches with automatic transmissions. Gaseous emissions of HC, CO, NO, aldehydes, formaldehyde, and acrolein were obtained simultaneously during the steady state operating modes for odor measurement. Some of the equipment and instruments utilized are shown in Figures 16, 17, and 18.

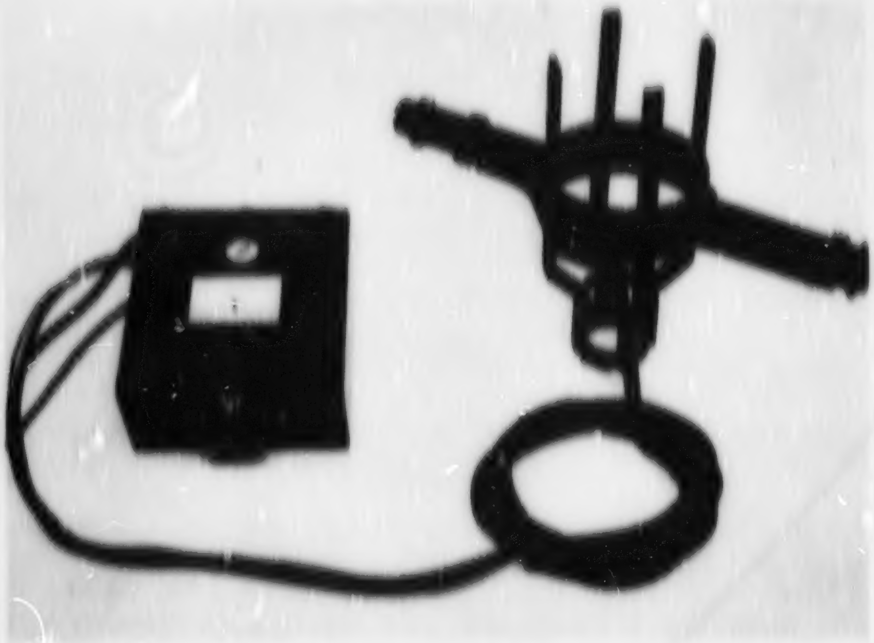

FIGURE 12. U.S. PHS DIESEL SMOKE OPACITY METER

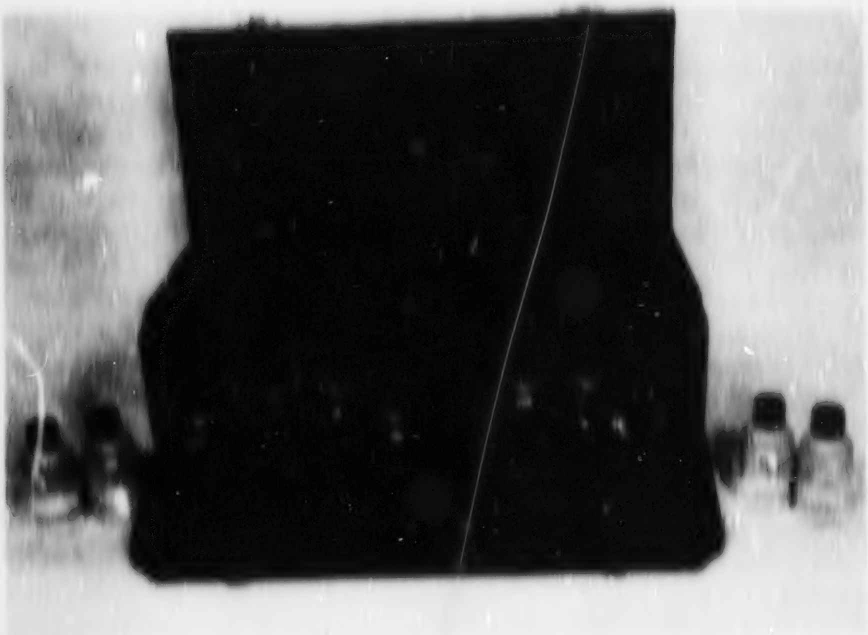

FIGURE 13. U.S. PHS DIESEL ODOR QUALITY-INTENSITY STANDARDS

FIGURE 14. SwRI TRAINED ODOR PANEL

FIGURE 15. SwRI TRUCK-BUS CHASSIS DYNAMOMETER AND INERTIA SIMULATION FACILITY

FIGURE 16. NONDISPERSIVE INFRARED ANALYSIS OF CO, NO, AND CO_2

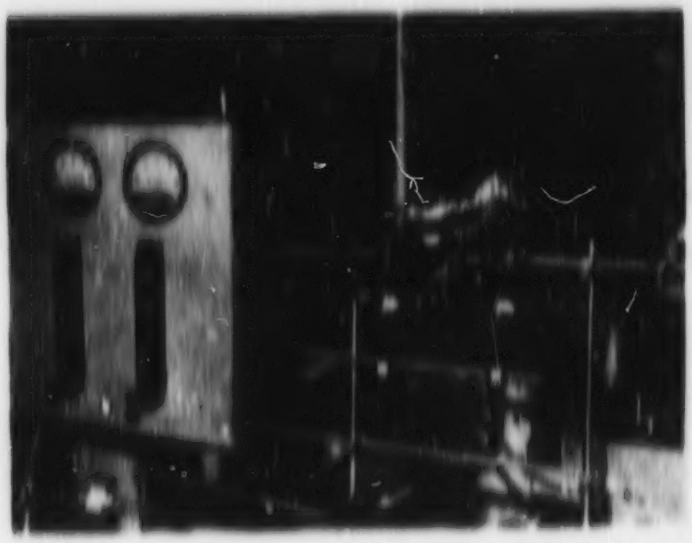

FIGURE 17. SAMPLING AND ANALYSIS APPARATUS

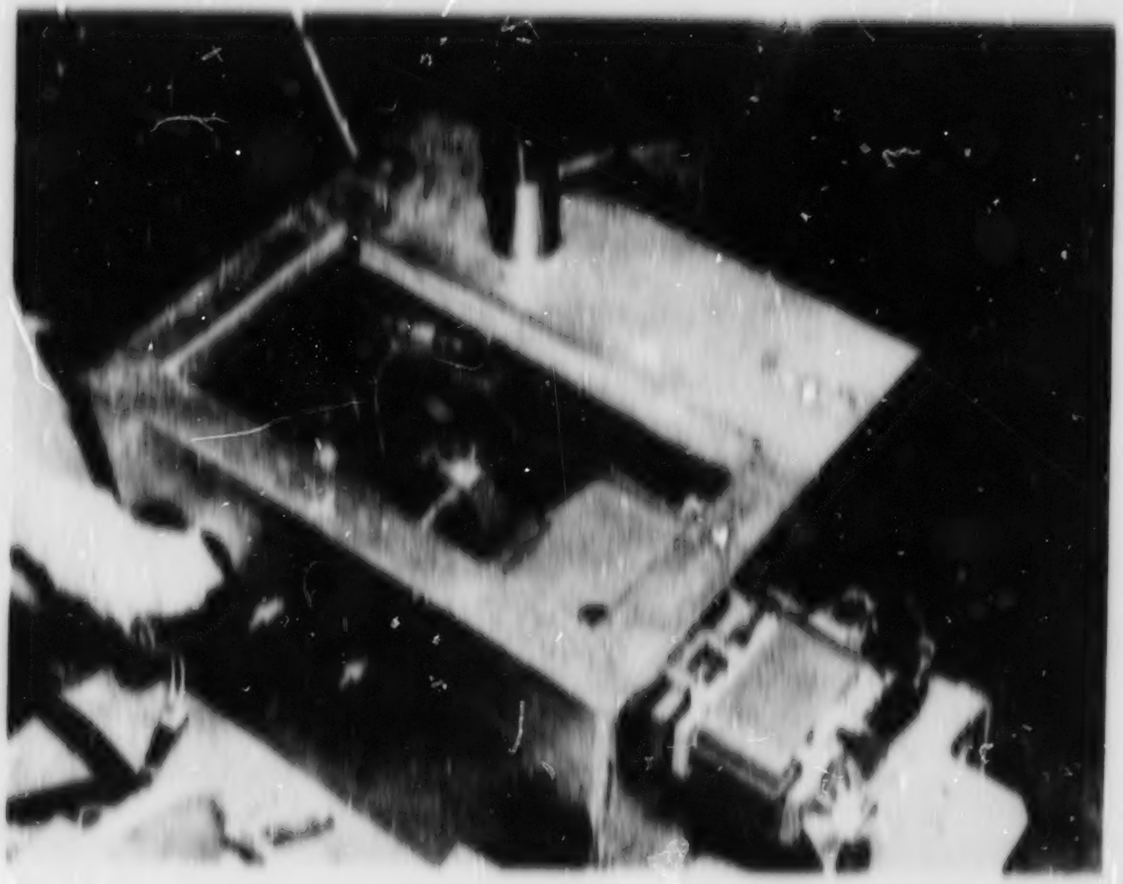

FIGURE 18. SwRI HIGH-TEMPERATURE HYDROCARBON ANALYZER

Some refinement of the procedures was made to make the EIP evaluation as accurate as possible. For example, the cruise odor conditions of 20, 30, and 40 mph at 40 rear-wheel hp were changed to 900 rpm (24 mph), 1200 rpm (32 mph), and 1500 rpm (40 mph), all at a fuel rate midway between the measured full-load and no-load fuel rate. This is known as "1/2-load" and seems to be a worthwhile improvement. It has decreased the potential variability due to transmission, rear axle, and tire power losses inherent in the old procedure.

Because of the extended operation involved for each bus, special steel-belted single-ply tires were obtained and the bus jacked up to reduce the weight on the rear tires. This safety precaution has paid off by allowing operation of a modified EMA, 13-mode cyclic test procedure. The chassis version of this procedure, described in detail in **Appendix A**, calls for a 39-min run at two engine speeds plus low idle. Since the 6V-71 engine in a two-speed automatic transmission GM bus operates over a wide speed range of 825 to about 1800 rpm, rated and intermediate (peak torque or 60 percent of rated speed, whichever is higher) did not apply. For the case of the 6V-71 in a bus, rated is 2000 rpm and intermediate is 1260 rpm.

In modifying the EMA procedure to be realistic with respect to municipal coach operation, an upper engine speed of 1600 rpm and a lower speed of 1000 rpm were selected. These modifications, especially the 1/2-load fuel rate were more conducive to optimum catalyst operation in that the speeds were increased as well as the power level as evident by higher exhaust temperatures. The times in modes were reduced to 2 min except modes 3, 7, 8, and 12, which remained 3 min. This resulted in a 30-min cycle which could be safely and repeatedly conducted. Incidentally, studies had been previously made and were verified that essential emission stabilization was achieved during the 2-min interval. Generally, the first 60 sec were used to change load, with the last 60 sec used to measure the emissions of CO, HC, and NO. Reference 9, **Appendix D**, contains a copy of the California regulations-procedures for 1973 and 1975 diesel HC, CO, and NO. Reference 13 is an SAE paper describing the rationale and test procedure.

G. Test Plan

The test plan employed was as involved and complex as any yet devised for fleet test emissions evaluation. The initial series of tests, requiring over two weeks per bus after kit installation, was made as follows:

(1) Interior and Exterior Noise Tests

(2) Installation of Kit

(3) Operation of 1 to 2 weeks--approximately 1000 miles

(4) Retest Interior and Exterior Noise

(5) Exhaust Emission Tests

(a) Odor, wet chemistry, gaseous emissions, and smoke LSN injectors (1.470) with catalytic muffler

(b) Gaseous emissions per modified EMA cycle LSN injectors (1.470) and catalytic muffler

(c) Odor, wet chemistry, gaseous emissions, and smoke LSN injectors (1.470) with stock muffler

(d) Gaseous emissions per modified EMA cycle LSN injectors (1.470) with stock muffler

(e) Odor, wet chemistry, gaseous emissions, and smoke 60S injectors (1.470) with stock muffler

(f) Gaseous emissions per modified EMA cycle 60S injectors (1.470) with stock muffler.

The second emissions tests were made after 25,000 miles of operation and repeated the above schedule.

III. NOISE TEST RESULTS

Noise was measured only before and after installation of the EIP kit. In order to properly quantify the noise reduction afforded by the EIP modification kit, three general types of tests were chosen: Exterior Drive-By, Interior Sound Level, and Interior Loudness. These tests are outlined in detail below.

A. Exterior Drive-By Test

This test was chosen to measure the reduction in loudness afforded by the installation of the EIP kit. For this test, the general procedure outlined in #SAE J672 "Measurement of Truck and Bus Noise" was chosen as it will parallel typical test runs on this type bus. A copy of this procedure is included in Appendix A of this report. The only modification made to the test procedures involved locating the microphone at 25 ft from the centerline of the bus path as shown in the Figure 19 test layout schematic.

If at some later date it becomes necessary to define the levels at 50 ft, the following equation may be used:

$$\text{SPL (in dB at 50 ft)} = \text{SPL (in dB at 25 ft)} - K(\text{dB})$$

where

$$K(\text{dB}) = 20 \log \left(\frac{25}{50}\right) = 6.02 \text{ dB}$$

Accordingly, the sound-pressure level at 50 ft will equal the sound pressure level measured at 25 ft minus 6 dB. The octave band data taken in these tests were then converted to sones (units of loudness) by the method outlined in the test code.

In addition to the acceleration tests specified in the SAE test code, a similar number of tests were made with each bus traversing the test course at a constant 20-mph cruise with the transmission in low range. In summary, two passes were made for each of the eight test conditions on each bus before and after the installation of the EIP kit. For convenience, these test conditions are listed below:

Acceleration with upshift in the last 50 ft of the course:

(a) Curbside with air-conditioning system on
(b) Curbside with air-conditioning system off
(c) Streetside with air-conditioning system on
(d) Streetside with air-conditioning system off.

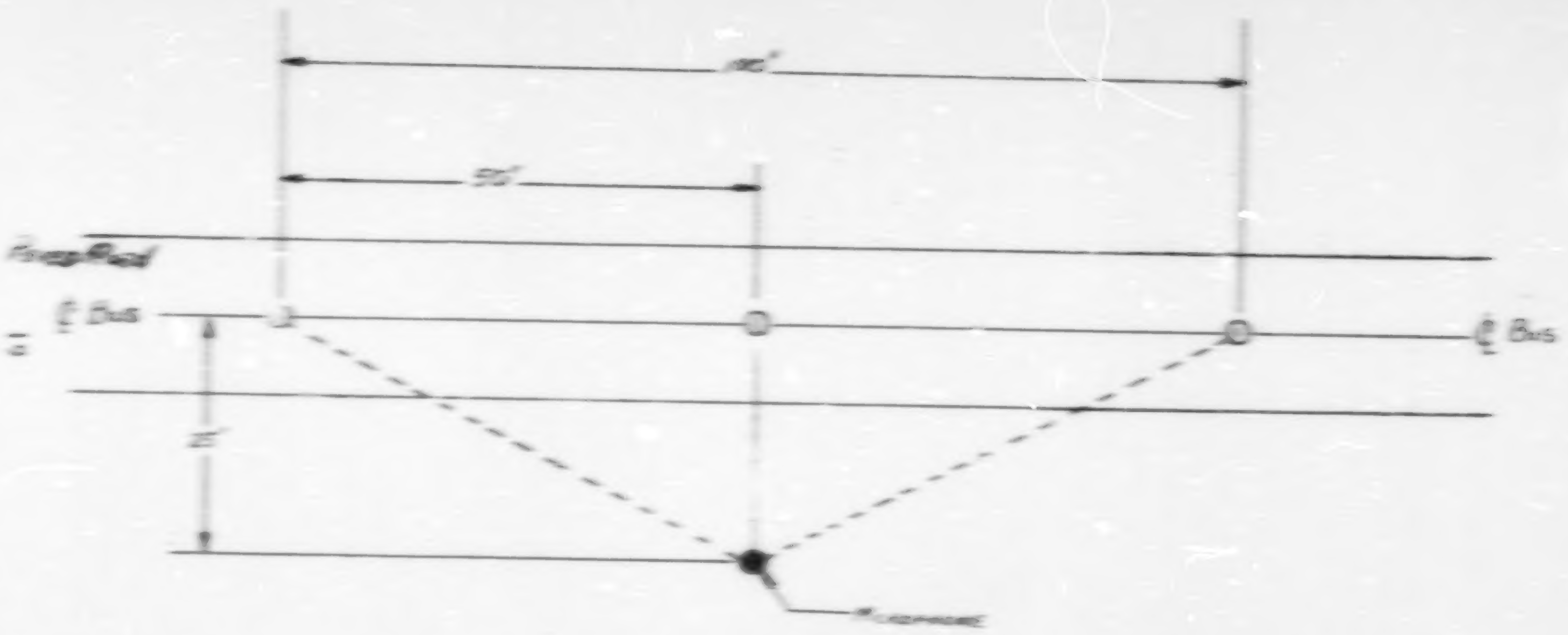
100'
50'
℄ Bus
℄ Bus
25'
Microphone

FIGURE 14. SCHEMATIC OF DRIVE-BY EXTERIOR
NOISE TEST LAYOUT

Constant speed over the test course at 20 mph in low range:

(a) Curbside with air-conditioning system on
(b) Curbside with air-conditioning system off
(c) Streetside with air-conditioning system on
(d) Streetside with air-conditioning system off.

Figure 20 shows some of the equipment which included a General Radio Type 1524-A data recorder, a General Radio Type 1560-P6 ceramic microphone with a General Radio Type 1562-A sound level calibrator, and a 1558-A octave band noise analyser. Figures 21 through 23 are photographs of one of the buses undergoing exterior drive-by noise tests. Figure 21 shows the field test site while Figures 22 and 23 are curbside and streetside views of the bus relative to the sound measuring equipment.

The results of the eight drive-by tests, made before and after the EIP was installed, are presented in Table 2. The values of this table are in SAE sones. It will be noted that the average percent reduction for the acceleration tests is considerably lower than that for the constant speed test. Reductions of up to 30 percent in loudness level were found during the 20-mph low-range, constant-speed drive-bys. The reduction in the acceleration-upshift noise level, however, was found to be lower, especially on the curbside measurements where an increase in loudness level was measured. It is probable that the increase in engine-upshift speed offset the improvements expected with the modified bus for curbside tests.

The streetside acceleration measurements indicated slight reduction overall. This is probably due to the relocation of the exhaust pipe in a vertical direction instead of a horizontal direction toward the center of the street. The exhaust, as it issues from the horizontal 3-in. tailpipe, makes a noticeable sound, and, to the casual observer, this sound is no longer evident with the vertical stack. As apparently helpful as the vertical stack is in this regard, the increase in upshift speed seems to nullify most of the important gains in noise reduction demonstrated in the constant-speed runs. There is, of course, some inherent test variability and, consequently, some error involved in the acceleration-upshift noise tests. Buses do not always automatically upshift the same way at the same speed. If the bus is viewed as a narrow band responsive system being excited by a narrow band driving force, relatively minor fluctuations in rpm at the shift point can produce drastic differences in the radiated noise. It is this phenomenon that helps to explain part of the loudness data seen for Bus 702 in test Nos. 5 and 7 and for Bus 707 in test No. 7.

Each loudness level in the table represents the average of two trials in that configuration and, as such, substantiates the validity of each test value. The occurrence of such anomalies in the level of the radiated noise could produce situations where either higher or lower percent-reductions

FIGURE 20. SOUND LEVEL MEASURING EQUIPMENT

FIGURE 21. TEST SITE AND TRACK

FIGURE 22. EXTERIOR NOISE TESTS--CURBSIDE

FIGURE 23. EXTERIOR NOISE TESTS--STREETSIDE

TABLE 2. LOUDNESS LEVEL OF MUNICIPAL BUSES ON DRIVE-BY TESTS IN S.A.E. SONES, GM-EIP FLEET TEST

Test No.	Test at	Air-Conditioning System	Side of Bus Facing Mike	Bus No. [illegible]		Bus No. [illegible]		Bus No. [illegible]		Arithmetic Average		
				Before	After	Before	After	Before	After	For All Buses		% Reduction
1	CONSTANT SPEED	ON	CURB	87	78	82	78	98	75	89	77	12.4
2		ON	STREET	107	103	105	97	148	90	119	97	18.5
3		OFF	CURB	91	91	81	78	107	66	90	76	17.8
4		OFF	STREET	101	100	139	96	142	65	126	86	32.1
5	ACCELERATION UPSHIFT	ON	CURB	69	92	68	76	81	96	73	88	(15.3)
6		ON	STREET	108	106	94	85	126	111	109	101	6.4
7		OFF	CURB	62	92	66	78	74	81	69	81	(22.3)
8		OFF	STREET	96	111	109	89	136	107	112	102	8.9

Average % reduction for constant speed tests 20.1
Average % reduction for acceleration tests (21.9)
Average % reduction for all tests 7.6

NOTE: Numbers in parentheses indicate an increase in the average loudness.

could be measured. Therefore, in an effort to provide data that could be considered typical (and not the best or worst possible), no effort was made to retest where these fluctuations were found. Several tests were repeated, however, when it was found that the shift points were not set in accordance with specifications or the transmission governor was noticed to be erratic and not repeatable. The overall effect of the air conditioner on these exterior noise measurements is judged to be minimal.

An overall summary of the exterior drive-by tests for all three buses is shown in Figure 24. The air conditioner made little difference, but the operating condition, cruise or transient, did. While marked reductions are evident at 20-mph constant speed, the reverse is indicated during the accel to upshift. This is due to the raising of the upshift engine speed per SIP recommendations.

B. Interior Sound Level Measurement

In an effort to provide some data which might relate to the Department of Labor (Walsh-Healey) Safety Criterion for Noise, measurements were made at three test points on the interior of the bus to establish the effect of the modification kit on interior noise levels. For this test, the following three test points were used:

(1) At the driver's ear

(2) At the ear level of a passenger seated next to the aisle in the seat across from the rear door

(3) At the ear level of a passenger seated in the center of the rear seat.

A General Radio Type 1565-A sound level meter and a General Radio Type 1562-A sound calibrator were used for these tests.

The results of the sound level measurements made inside the bus are presented in Table 3. These levels are the average of two separate readings for each test. The operating modes were identical to those used in the drive-by tests.

The "Average for All Buses" is not the arithmetic average of the three numbers but rather represents the average of the sound pressures for the three cases. Mathematically, this value may be derived using the following equation:

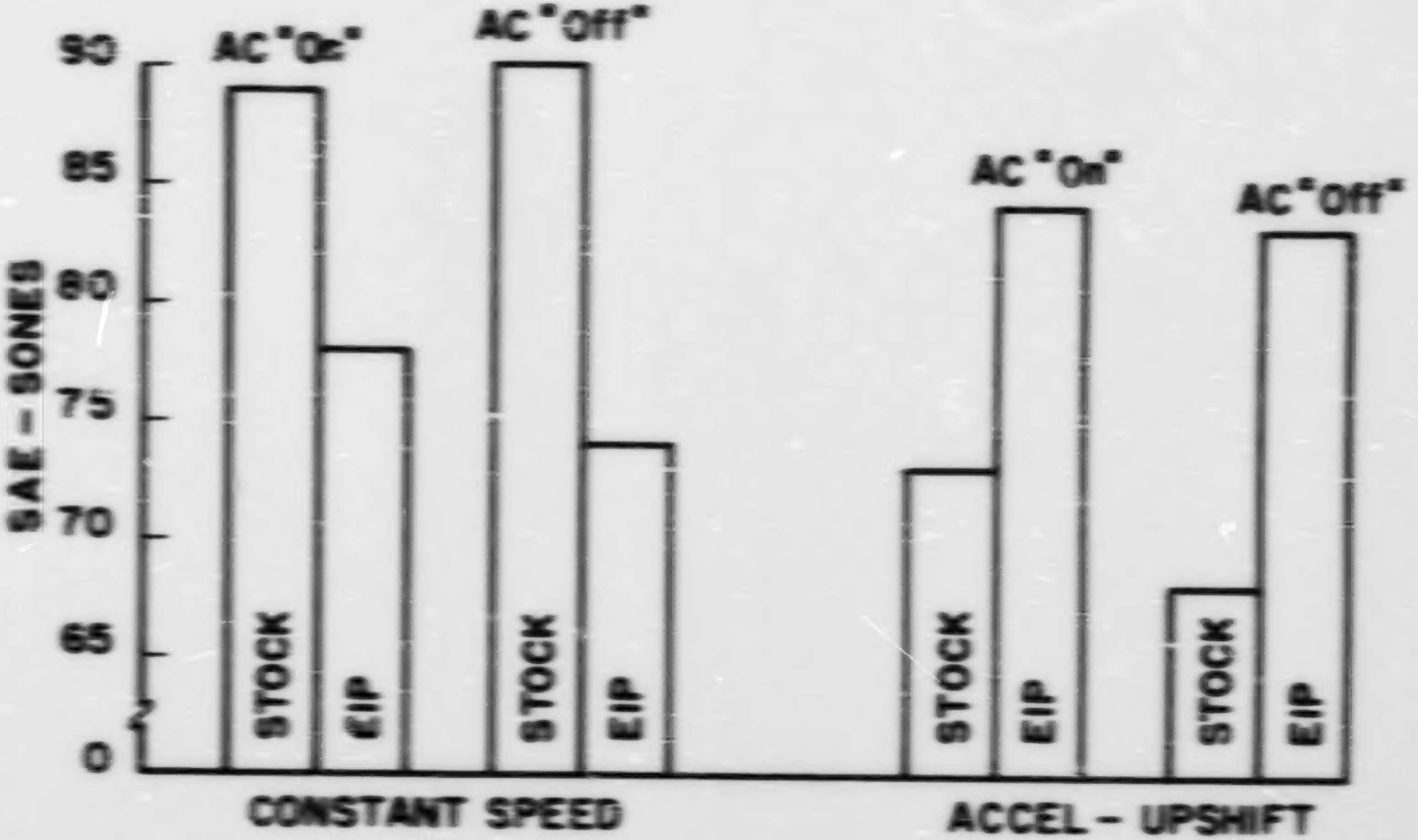

FIGURE 24. EXTERIOR SOUND—EIP VS STOCK CURBSIDE - ALL BUSES

TABLE 7. AVERAGE SOUND PRESSURE LEVEL FOR TWO-TESTS ON THE INTERIOR OF MUNICIPAL BUSES (IN dBA), GM-EIP FLEET TEST

Test No.	Test At	Air-Conditioning System	Test Point*	Bus No. 712		Bus No. 716		Bus No. 717		Average for All Buses		
				Before	After	Before	After	Before	After	Before	After	Reduction in dBA
1	CONSTANT SPEED	ON	DRIVER	76.0	74.5	77.0	73.5	77.0	74.0	77.4	74.0	3.4
2		ON	MID	80.4	78.0	78.5	76.5	80.7	78.5	79.9	78.1	1.8
3		ON	REAR	86.7	84.0	85.7	83.0	86.0	82.0	86.1	83.0	3.1
4		OFF	DRIVER	74.0	68.0	71.1	66.0	74.5	69.0	74.4	67.8	6.6
5		OFF	MID	76.5	71.0	74.9	70.0	77.7	73.0	76.4	71.4	5.0
6		OFF	REAR	83.7	75.5	80.9	75.0	84.0	78.0	82.8	76.3	6.5
7	ACCELERATION UPSHIFT	ON	DRIVER	77.5	75.0	75.8	74.0	76.1	78.5	76.6	76.0	0.6
8		ON	MID	81.0	78.5	78.0	77.0	81.9	81.0	80.6	79.0	1.6
9		ON	REAR	86.3	84.0	83.0	85.0	85.5	87.0	85.1	85.6	(0.5)†
10		OFF	DRIVER	74.0	69.0	71.9	66.0	73.0	74.0	72.8	70.3	2.5
11		OFF	MID	77.5	73.0	76.3	70.0	77.0	76.0	76.9	73.7	3.2
12		OFF	REAR	85.3	77.0	81.2	75.0	86.0	80.5	82.9	77.8	5.1

---

*Driver – The microphone is located at the driver's ear.
Mid – The microphone is located at the ear level of a passenger seated next to the aisle across from the rear door of the bus.
Rear – The microphone is located at the level of a passenger seated in the center of the rear seat.
†Indicates an increase in the average level.

$$\mathrm{SPL}_{\mathrm{ave}} = 20 \log \left[\frac{10^{\left(\frac{\mathrm{SPL}_1}{20}\right)} + 10^{\left(\frac{\mathrm{SPL}_2}{20}\right)} + 10^{\left(\frac{\mathrm{SPL}_3}{20}\right)}}{3} \right]$$

where

$\mathrm{SPL}_{\mathrm{ave}}$ = the average sound pressure level in dBA *re* 0.00002-μ bar

and

SPL_N = the individual sound pressure levels for each bus in dBA *re* 0.00002-μ bar

On both the constant-speed and acceleration-upshift runs, the three-bus average interior sound-pressure levels in dBA were found to be lower in the EIP kit-equipped buses, except for test No. 9 where Buses 704 and 702 had higher readings at the rear seat (accel-upshift). The reductions noted were greatest during the constant-speed runs with the air conditioner inoperative. The air-conditioning system in these three vehicles is a significant noise source and had a noticeable effect on interior noise levels. The air-conditioning noise tended to mask the effect of the EIP kit. Although reductions on the order of 6 dBA were found during the 20-mph runs with AC "off," approximately half this improvement was noted when the AC was operating.

During the acceleration to upshift runs, the AC seemed to have about the same effect on the overall readings, i.e., about half, or less, of the reduction found with the AC "off." The same comments regarding the test repeatability, variability, and possible error inherent in the acceleration through upshift tests applies to these readings as during the exterior tests.

Figure 25 is an overall, 3-bus, summary of the interior sound measurements with and without air conditioner operative at constant speed during the accel-upshift condition. This bar chart representation illustrates the improvement possible by the EIP kit under both conditions and indicates how the amount of improvement is noticeably reduced when the air conditioner was operating.

C. Interior Loudness Test

To gage the apparent reduction in the interior noise levels afforded by the EIP modification kit, octave band data were taken at the ear level of a passenger seated at the rear of the bus. These data were then converted to sones in the manner illustrated in the SAE J672 test mentioned earlier. The sound measuring instruments were the same as those used during the exterior

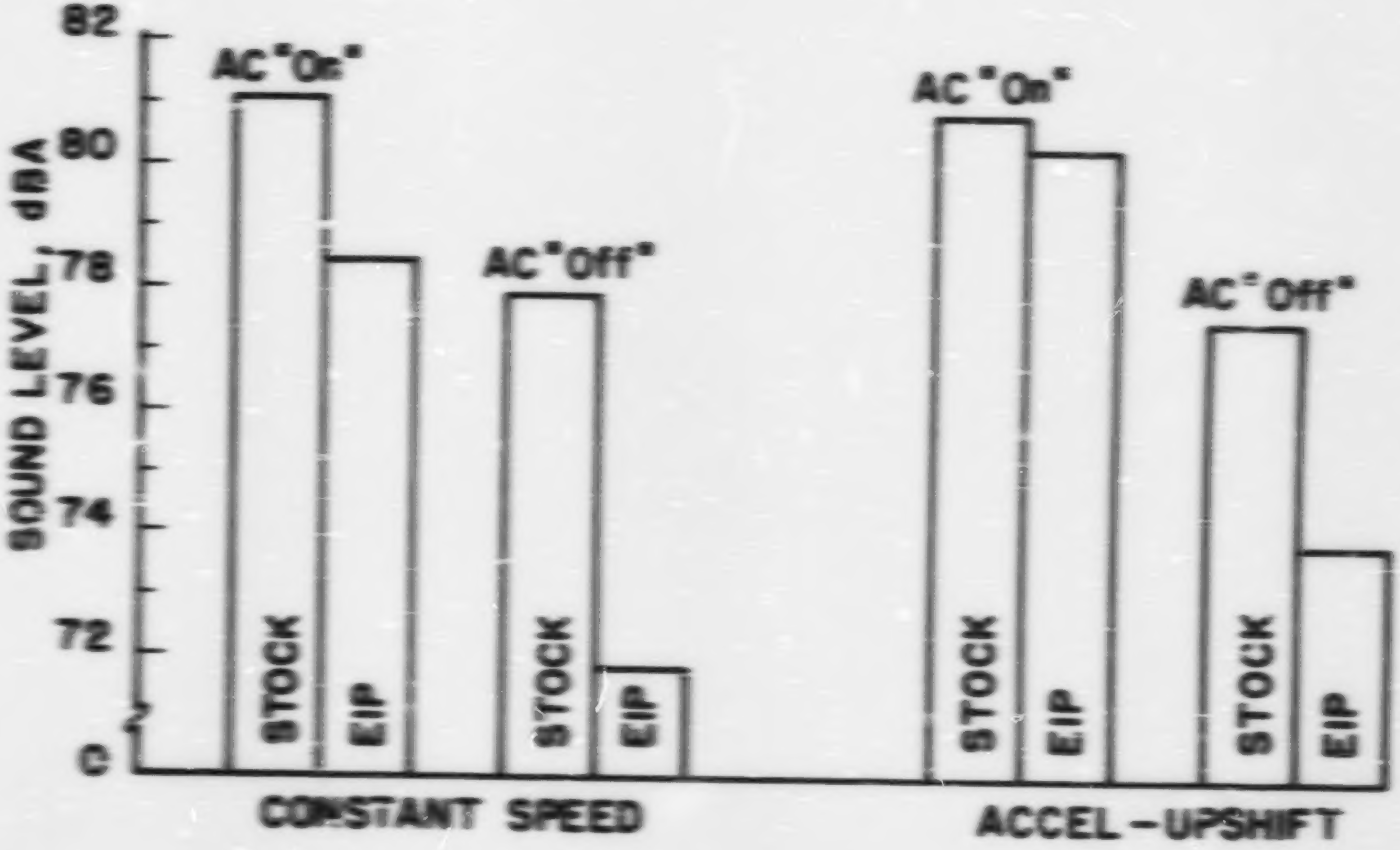

FIGURE 25. INTERIOR SOUND--EIP VS STOCK dBA ALL BUSES

drive-by tests, except they were operated from a large bus battery through a suitable inverter.

The last set of measurements, listed on Table 4, were loudness tests made at passenger ear level for a person seated in the middle of the rear seat of the bus. According to the octave band analysis, the apparent sound level was consistently reduced for all buses in both constant and transient modes. Greatest improvement was noted during the 20-mph cruise. Levels measured for Bus 704 (Test I) were suspect. Although the data appear to actually represent test conditions, a slight difference in engine speed could account for the inconsistent result.

The literature on the Environmental Improvement Program suggests that there will be an interior noise reduction of 8 dBA on the 8V-71 and 4 dBA on the 6V-71-powered municipal coaches. Reductions of 4 dBA in interior noise were measured under certain conditions, namely, with the air conditioner inoperative. For buses having AC systems identical to the three units tested, it would appear that a reduction of less than 4 dBA would result if the measurements obtained with these three vehicles are to be considered typical. The increase in upshift speed is considered to be one reason for the diminished dBA reductions measured in this work. It would seem, as a passing observation, that the need to reduce the AC system noise should be the area of greatest concern for interior noise reduction. The noise from the air conditioning units on these three buses caused much greater differences in interior loudness and dBA readings than did the EIP kit even under optimum test conditions. Perhaps the EIP kit should also include a treatment for the AC system since more and more city buses are now air conditioned. This completes the noise test portion of the EIP fleet test.

TABLE 4. LOUDNESS LEVEL IN SONES AT THE BACK SEAT OF MUNICIPAL BUSES GM-EIP FLEET TEST

Test No.	Test At	Air-Conditioning System	Bus No. 702		Bus No. 704		Bus No. 707		Arithmetic Avg., All Buses		% Reduction
			Before	After	Before	After	Before	After	Before	After	
1	CONSTANT SPEED	ON	113.0	70.0	106.3	155.0	154.0	85.0	133.5	77.5	42.0*
2		OFF	95.0	75.0	86.0	62.0	116.0	59.0	100.0	65.0	35.0
3	ACCEL UPSHIFT	ON	125.0	107.0	126.0	121.5	153.0	133.0	135.0	121.0	10.4
4		OFF	104.0	75.0	104.0	90.0	110.5	106.0	106.0	91.0	14.2

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*Bus 704 data not included in this average because data are suspect.

IV. EMISSIONS TEST RESULTS

The measurements, made in a back-to-back manner to facilitate direct comparison, are described first for odor, then smoke, followed by selected chemical gaseous measurements during the odor tests with cyclic emissions (13-mode) listed last. In each case, the stock configuration (stock muffler and used 60S injectors at 1,470) is listed first followed by the simple replacement of injectors with 60 LSN (at 1,470) and then with the EIP configuration of catalytic muffler plus 60 LSN injectors.

A. Odor

The odor evaluations indicated a significant reduction when the improved injectors were used in all buses under most all conditions with idle showing less improvement than the other conditions. This overall result is illustrated in Figures 26 through 31 which are bar charts representing the sum of "D" + "B" + "O" + "A" + "P" panel ratings. Each figure is for one of the six operating conditions and shows on a comparative basis the ratings for the stock muffler plus LSN injectors and catalytic muffler plus LSN units relative to the unmodified bus odor. A review of these six bar charts indicates the generally consistent improvement in odor reduction available from the LSN injectors while the catalytic muffler lacked noticeable improvement in exhaust odor.

These trends are based on the extensive odor data tabulated in summary form in Tables 5, 6, and 7 for Buses 702, 704, and 707, respectively. The presence of asterisk values for the U_s nonparametric statistical test for difference indicates the net change to be within the spread of the experimental data and not statistically different. There is no doubt that the LSN injectors are doing an excellent job, are mainly consistent, and most reductions are not only substantially but significantly different.

In contrast, the catalytic muffler, operated in conjunction with the improved injectors, had little or no overall net positive effect on reducing exhaust odor. In some instances, specifically the initial tests of Bus 707, the catalytic muffler seemed to be somewhat effective. But, after 25,739 miles, the initial improvements disappeared and the catalytic muffler was found to be largely ineffective as that found for the the other two buses at the initial and first interim inspection. It may have been that the catalyst was new and still effective after the 911 miles of operation (99 hr). It has been our experience that a sometimes more penetrating, pungent, sour odor may occur from a catalytic muffler which has, in the past, been attributed to partial conversion of less smelly compounds into those more noticeable. The interesting action of the catalyst under idle on Bus 707, and, to a lesser extent, 704 initial tests, may be attributed to the residual heat stored in the 40-lb charge of catalyst in the muffler triggering reactions even though the inlet gas temperature is around 225° to 250°F.

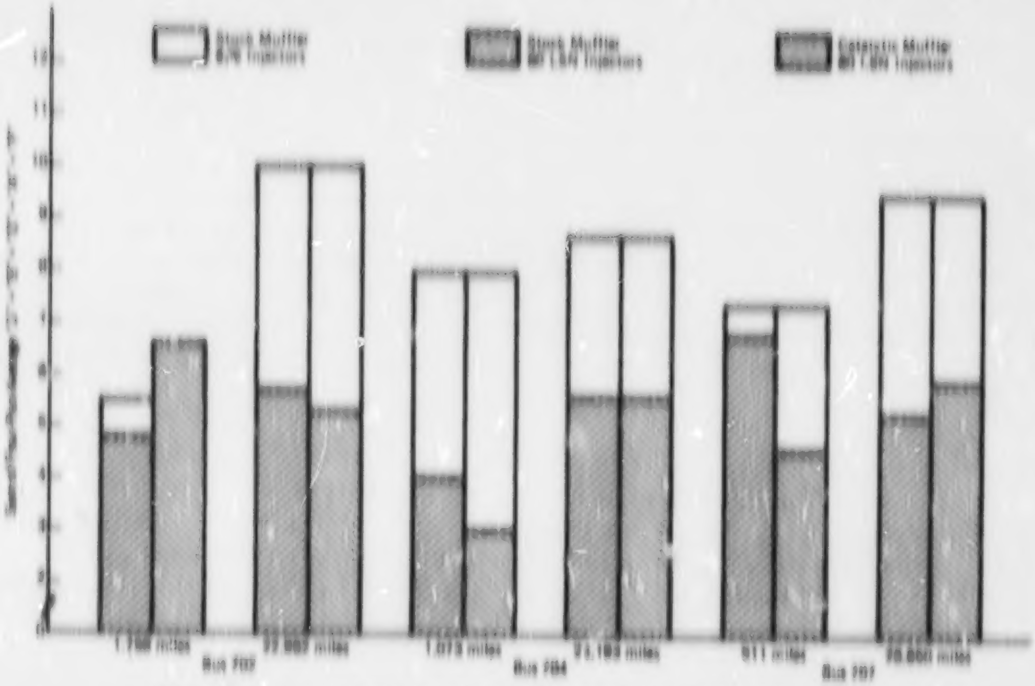


FIGURE 26. ODOR EVALUATION COMPARISON--
24 MPH, 900 RPM, 1/2 LOAD

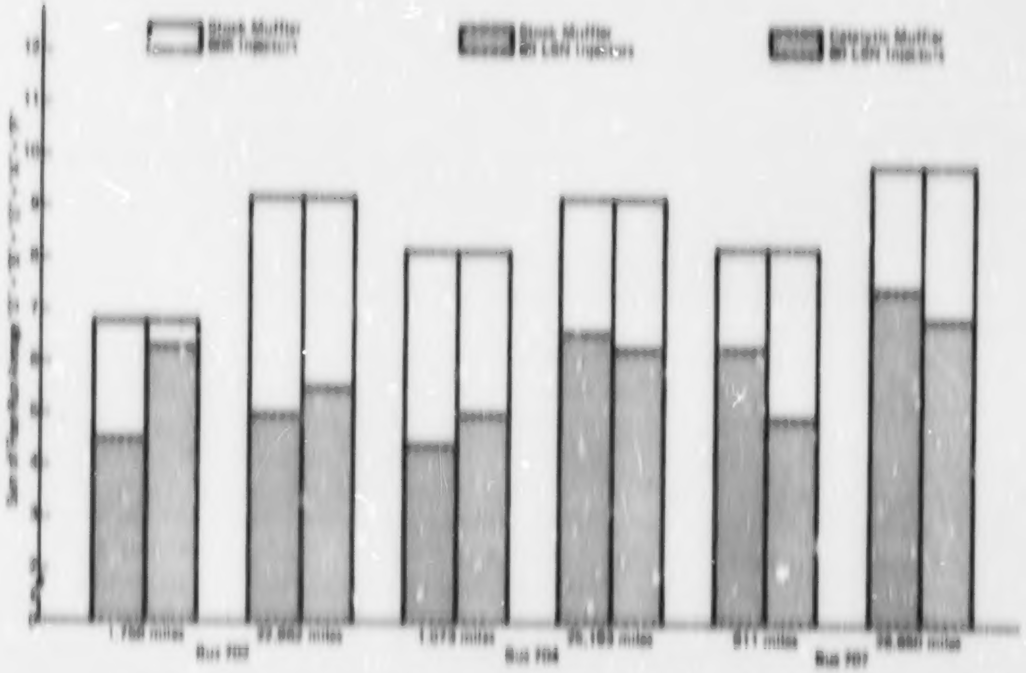


FIGURE 27. ODOR EVALUATION COMPARISON--
32 MPH, 1200 RPM, 1/2 LOAD

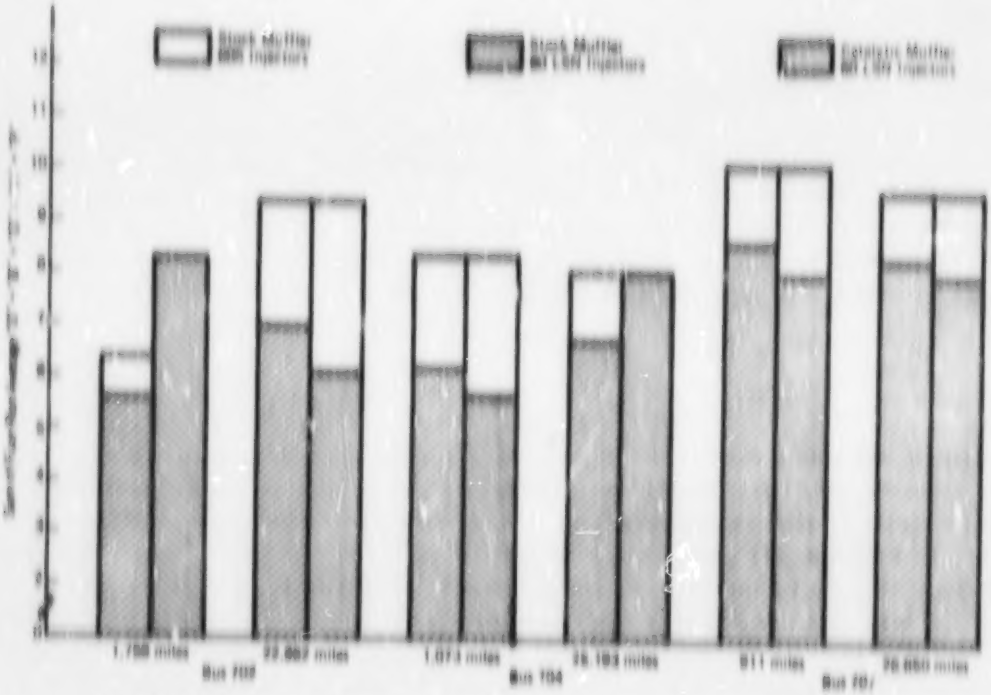


FIGURE 28. ODOR EVALUATION COMPARISON--
40 MPH, 1500 RPM, 1/2 LOAD

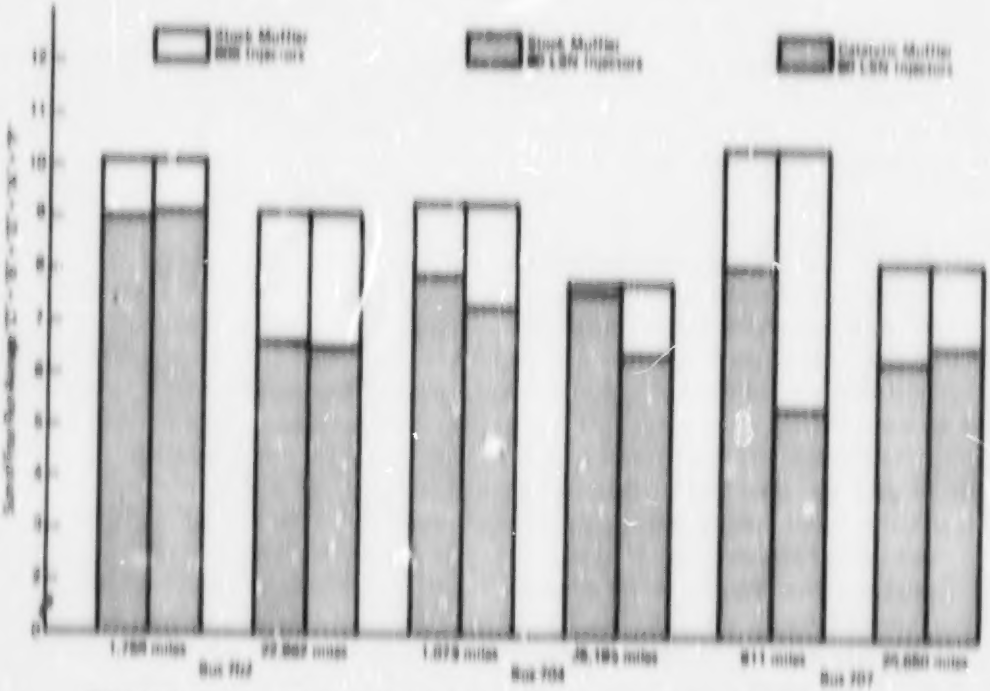


FIGURE 29. ODOR EVALUATION COMPARISON- IDLE

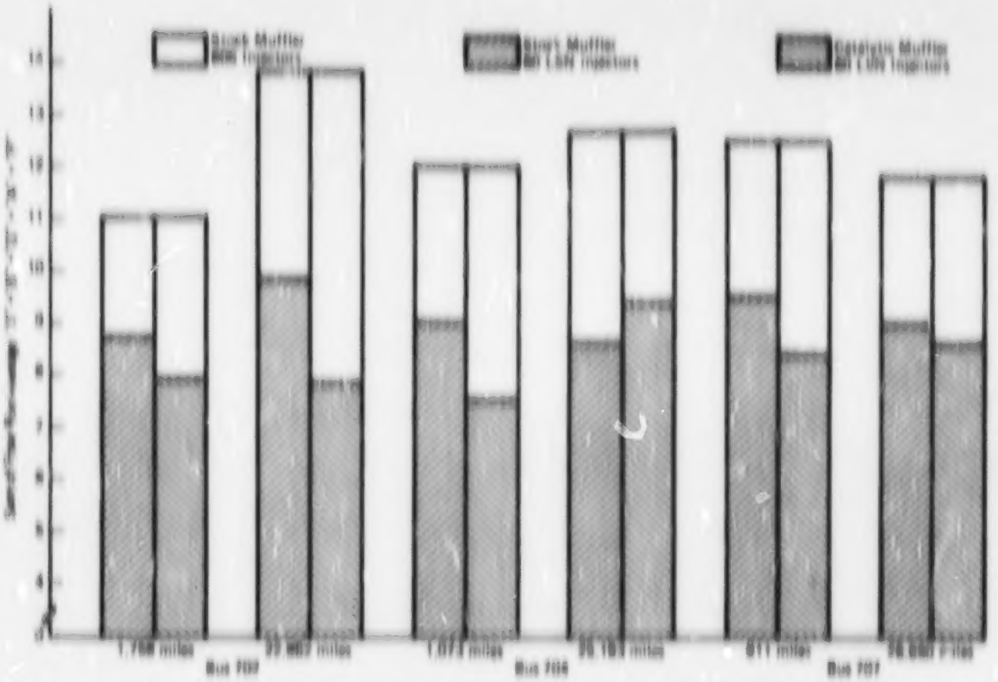


FIGURE 30. ODOR EVALUATION COMPARISON--
IDLE ACCELERATION

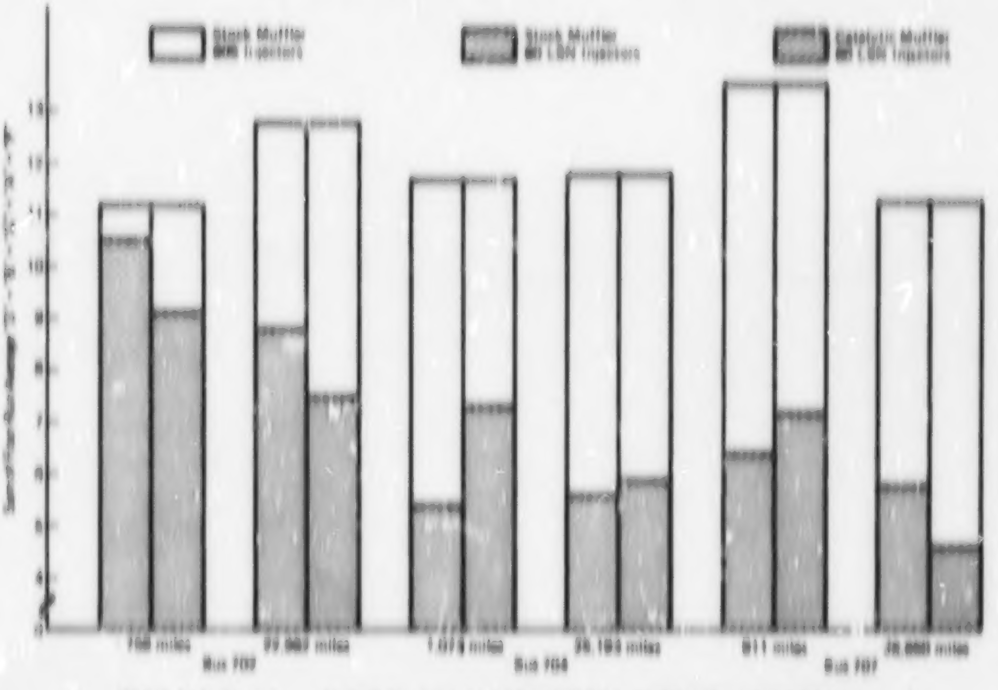


FIGURE 31. ODOR EVALUATION COMPARISON--
DECELERATION

TABLE 5. OVERALL SUMMARY OF ODOR EVALUATIONS TWO-YEAR FLEET TEST OF GM-EIP KIT
(Bus 702)

Operating Condition	Test Miles	Engine Hours	Test Date	Test Configuration	"D" Composite Modifications		"B" Burnt Modifications		"O" Oily Modifications		"A" Aromatic Modifications		"P" Pungent Modifications	
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1,708	183	10/1/70 9/29, 9/30/70	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,731	[illegible]	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1,708	183	10/1/70 9/29, 9/30/70	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,731	[illegible]	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1,708	183	10/1/70 9/29, 9/30/70	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,731	[illegible]	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	1,708	183	10/1/70 9/29, 9/30/70	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,731	[illegible]	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle - Accel	1,708	183	10/1/70 9/29, 9/30/70	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Decel	1,708	183	10/1/70 [illegible]	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,731	[illegible]	Stock, 0 Modification Net Change [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 6. OVERALL SUMMARY OF ODOR EVALUATIONS, TWO-YEAR FLEET TEST OF GM-EIP KIT (Bus 704)

Operating Condition	Test Miles	Engine Hours	Test Date	Test Configuration	"D" Composite [illegible]		"B" Burnt [illegible]		"O" Oily [illegible]		"A" Aromatic [illegible]		"P" Pungent [illegible]	
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mph [illegible] rpm [illegible] load	1,071	98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	25,193	2,061	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mph [illegible] rpm [illegible] load	1,071	98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	25,193	2,061	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mph [illegible] rpm [illegible] load	1,071	98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	25,193	2,061	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	1,071	98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	25,193	2,061	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle - Accel	1,071	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	25,193	2,061	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Decel	1,071	98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	25,193	2,061	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 7. OVERALL SUMMARY OF ODOR EVALUATIONS, TWO-YEAR FLEET TEST OF GM-EIP KIT (Bus 707)

Operating Condition	Test Miles	Engine Hours	Test Date	Test Configuration	"D" Composite [illegible]		"B" Burnt [illegible]		"O" Oily [illegible]		"A" Aromatic [illegible]		"P" Pungent [illegible]	
					1st	[illegible] Trial	1st	[illegible] Trial	1st	[illegible] Trial	1st	[illegible] Trial	1st	[illegible] Trial
[illegible]	911	90	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,071	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	911	90	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,071	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	911	90	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,071	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	911	90	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,071	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle - Accel	911	90	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,071	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Decel	911	90	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,071	[illegible]	Stock, S Modification Net Change U, Statistic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

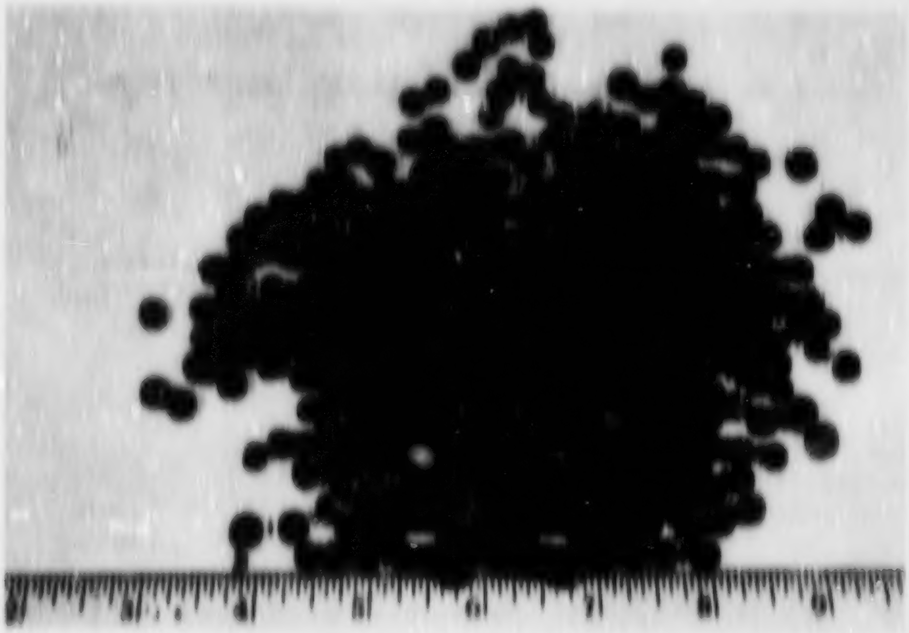
Since the catalytic muffler was expected to have its greatest impact on noticeable odor, the results of inspection and analysis during the first interim test are included in this subsection. Figure 32 shows new catalyst and used catalyst material after 26,650 miles of operation. More broken pieces were found in the used catalyst and, of course, the appearance was a shiny black compared to the usual dull gray appearance when new. The catalyst poured fairly freely from the muffler and when weighed was found to have only slightly attrited during the first period of operation. Table 8 lists only the catalyst charge when new, according to GM Truck and Coach Division, and the screen size of a sample of new material. The used catalyst data are listed next and indicate essentially no change in catalyst charge while screen size indicates some attrition and size reduction.

At the initial inspection, it was found that the muffler was completely full of catalyst material. It may have been that more than the 40-lb charge was installed in the unit during installation and it is uncertain whether the material was preweighed. This is a small point, however, as the catalytic muffler was found to be essentially as full at the first interim as at the initial inspection. The catalyst substrate, nominal 1/4-in.-diameter alumina (Al_2O_3) spheres, appears to be of hard, tough formulation and resistant to excessive abrasion, erosion, or thermal spalling and cracking. It is not certain whether the Zone 61 copper oxide catalyst, carried mainly on the surface as a coating has been worn off or otherwise rendered ineffective by this type of service. According to Davison Chemical Division of W. R. Grace, about 10 to 15 percent of the catalyst coating penetrates the alumina substrate. The odor panel results leave little doubt that the catalytic muffler is ineffective. The exact reason for lack of performance is not known from these studies.

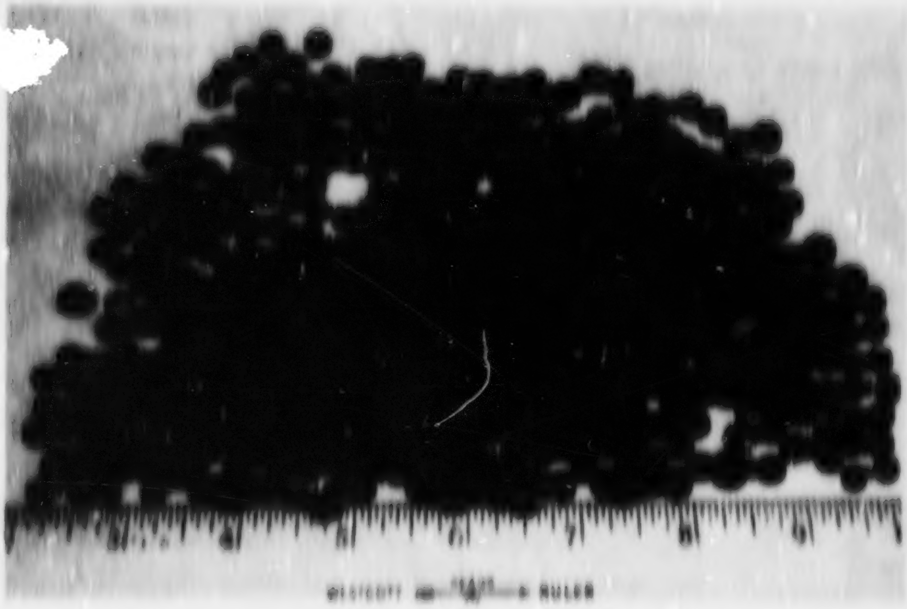
Contained in Appendix B are the 4-run summaries of odor panel ratings. Each table summarizes the results for one odor panel day and one day was used for evaluation of each treatment or each bus. These more detailed results are included for further study of run-to-run repeatability, variability, etc.

B. Smoke

A summary of the simulated Federal Smoke Test results is contained on Table 9. To place the "a" acceleration and "b" lugdown factors into perspective, the limit of visibility is normally 3 to 4 percent opacity. This means that only Bus 704, in a stock configuration, produced enough smoke during the initial inspection to be particularly noticeable (6 to 8 percent). The LSN injectors were quite consistent during the initial inspection in reducing smoke. With the exception of Bus 707, this improvement was also found at the first interim inspection. Bus 707 seemed to produce slightly more smoke with LSN versus the stock injectors. One possible reason for this behavior will be discussed later in this section.



New Catalyst



Used Catalyst

FIGURE 14. NEW AND USED CATALYST MATERIAL

TABLE 8. FIRST INTERIM CATALYST INSPECTION

New Catalyst Data

Charge when new, lb	40*
Screen Size When new	86.5% > 1/4 inch
	1/8 inch < 13.5% < 1/4 inch

Used Catalyst Data

Bus 702 - 22,962 miles	
Charge, lb	42.25
Screen size	53% > 1/4 inch
	1/8 inch < 47% < 1/4 inch
Bus 704 - 25,193 miles	
Charge, lb	41.25
Screen size	64% > 1/4 inch
	1/8 inch < 36% < 1/4 inch
Bus 707 - 26,650 miles	
Charge, lb	39.5
Screen size	50% > 1/4 inch
	1/8 inch < 50% < 1/4 inch

---

*Per GM Truck and Coach Division.

TABLE 9. OVERALL SUMMARY OF SIMULATED FEDERAL SMOKE TEST, TWO-YEAR FLEET TEST OF GM-EIP KIT

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figures 33, 34, and 35 are reproductions of a single acceleration-lugdown smoke test procedure for units 702, 704, and 707, respectively. Each figure contains a chart taken during the first interim inspection with LSN injectors and stock muffler installed. The most important aspect of these traces is the very low smoke output of the engines with LSN injectors after about 25,000 miles of operation.

Table 10 is a tabulation of the smoke and power measurements taken over a range of steady state engine speeds from 1000 to 2000 rpm in 200-rpm increments. The smoke measurements confirm the lugdown readings of the Federal Test Procedure. The characteristic of this engine to increase in smoke discharge as the engine speed is decreased is unchanged by the EIP kit, catalytic muffler, or LSN injectors.

It is also interesting to note that Bus 707 first interim inspection results were slightly, but consistently, higher with the LSN injectors than with the stock injectors. Recall that the LSN injectors were installed and adjusted to 1.470 setting at the start of the field test. Comparisons were made relative to used S injectors set at 1.470. After approximately 25,000 miles, the first interim inspection was made in which the LSN injectors were operated in an undisturbed, as-received condition. Then, the settings were measured, injectors removed, and the S injectors installed at 1.470.

The recorded injector settings are listed on Table 11. A review of these data indicates only a very nominal amount of wear during the first period of operation except for two injectors, left bank, cylinders 1 and 2 of Bus 707, which had substantial increases. This could well account for the increased smoke from this engine as it represents a maladjusted injector. The larger the setting, the later the start of fuel injection and this is known to increase engine smoke and to decrease nitric oxide. Please refer to Section VIII of Part IV final report (Ref. 5) for details on injector timing experiments. It is uncertain at this time the reason for the change in setting of these two injectors. Normal wear will not result in this large a change in so short a time. According to the San Antonio Transit System, the bronze rocker arm roller that actuates the injector can wear rapidly, resulting in late injection. The increased opening pressure of the "N"-type injector has caused more rapid wear of this component than with "S"-type injectors. All injectors were replaced to their respective settings as-removed (not 1.470) and the test continued.

C. Gaseous Emissions

The results in this section include data obtained simultaneously with the odor panel runs and the 13-mode schedule.

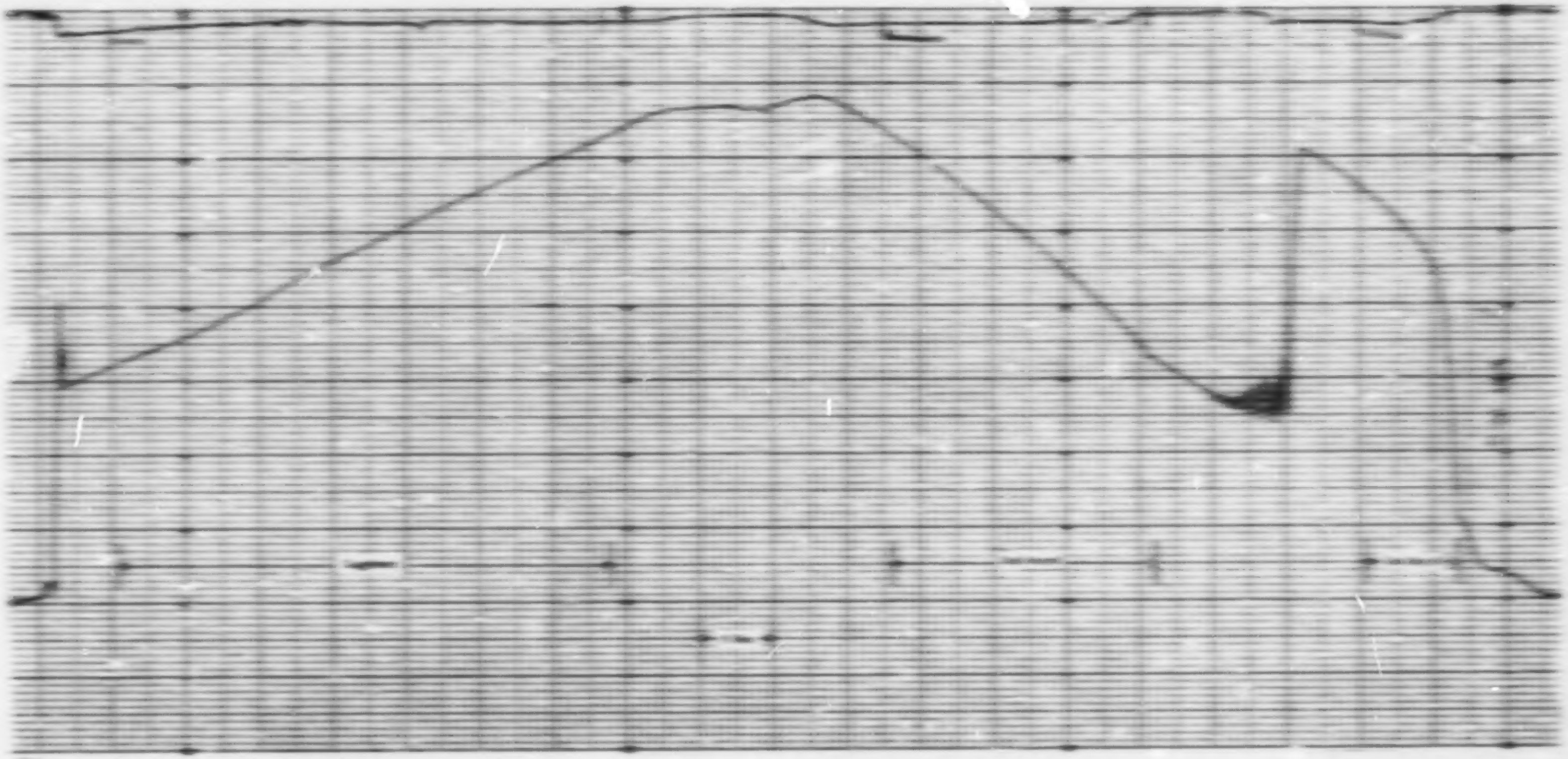


Chart Calibration--
100% Chart = 2400 RPM
0% Chart = 100% Smoke Opacity

Chart Reading--
Start/End 1st Accel:
31% to 75%

Start/End 2nd Accel:
52.5% to 83%
Start/End Lugdown:
83% to 52.5%

FIGURE 31. REPRESENTATIVE ACCEL--LUGDOWN SMOKE TRACE--BUS 702
FIRST INTERIM INSPECTION--LSN INJECTORS

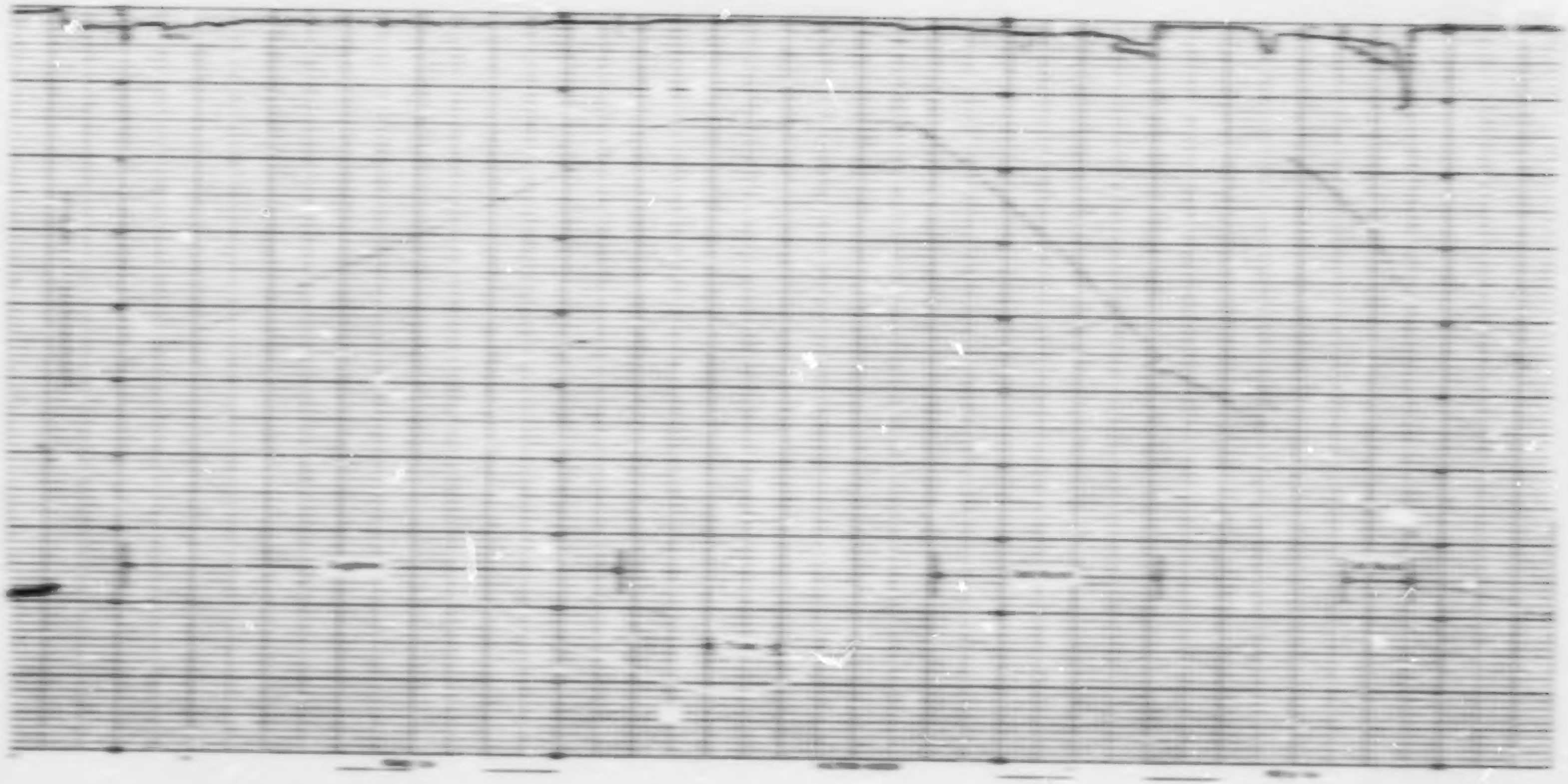


Chart Calibration--
100% Chart = 2400 RPM
0% Chart = 100% Smoke Opacity

Chart Reading--
Start/End 1st Accel:
31% to 75%

Start/End 2nd Accel:
52.5% to 63%
Start/End Lugdown:
63% to 52.5%

FIGURE 34. REPRESENTATIVE ACCEL--LUGDOWN SMOKE TRACE--BUS 704
FIRST INTERIM INSPECTION--LSN INJECTORS

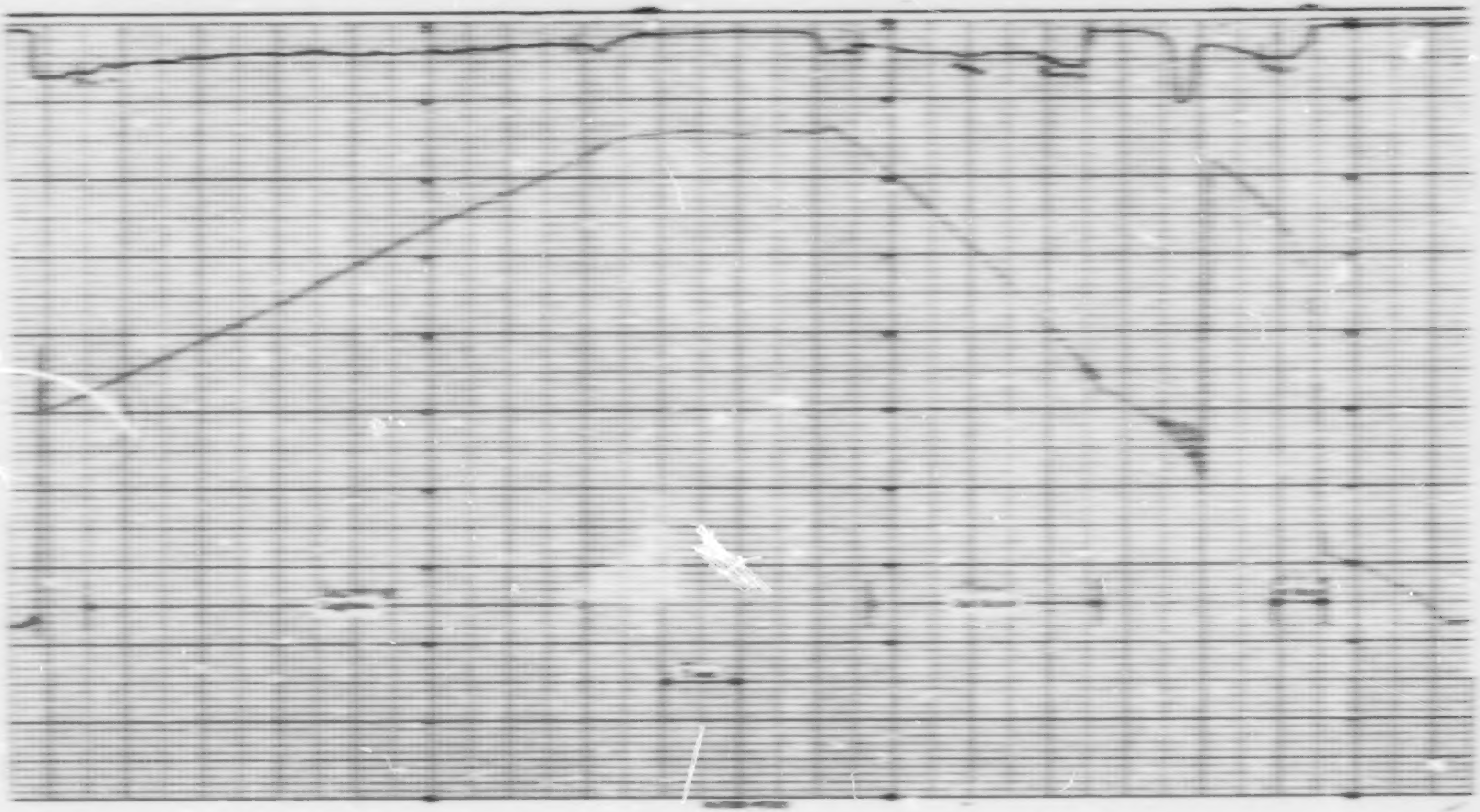


Chart Calibration--
100% Chart = 2400 RPM
0% Chart = 100% Smoke Opacity

Chart Reading--
Start/End 1st Accel: 31% to 75%
Start/End 2nd Accel: 52.4% to 83%
Start/End Lugdown: 83% to 52.5%

FIGURE 35. REPRESENTATIVE ACCEL--LUGDOWN SMOKE TRACE--BUS 707
FIRST INTERIM INSPECTION--L20 INJECTORS

TABLE III. OVERALL SUMMARY OF SMOKE AND POWER MEASUREMENTS, TWO-YEAR FLEET TEST OF GM-EIP KIT

Bus No.	Engine Speed, rpm	Initial Inspection						First Interim Inspection					
		5 Stock		15% Stock		15% Cat.		5 Stock		15% Stock		15% Cat.	
		Smoke, %	Power, hp	Smoke, %	Power, hp	Smoke, %	Power, hp	Smoke, %	Power, hp	Smoke, %	Power, hp	Smoke, %	Power, hp
707	1000	64	78	20	79	11	78	72	69	120	71	78	76
	1200	47	[illegible]	19	[illegible]	09	[illegible]	52	[illegible]	61	85	56	[illegible]
	1400	36	100	13	100	07	100	40	[illegible]	63	[illegible]	42	[illegible]
	1600	39	[illegible]	14	[illegible]	07	[illegible]	31	102	47	100	35	105
	1800	34	102	10	102	05	102	29	[illegible]	42	[illegible]	34	[illegible]
	2000	30	[illegible]	11	[illegible]	06	[illegible]	26	[illegible]	36	[illegible]	31	105
704	1000	122	[illegible]	38	71	17	[illegible]	73	[illegible]	46	72	78	72
	1200	93	76	21	[illegible]	13	82	51	[illegible]	38	[illegible]	53	[illegible]
	1400	75	[illegible]	13	[illegible]	08	85	40	[illegible]	25	[illegible]	41	[illegible]
	1600	55	[illegible]	15	[illegible]	09	92	29	[illegible]	15	97	32	[illegible]
	1800	55	85	12	91	08	95	24	[illegible]	15	[illegible]	32	[illegible]
	2000	46	100	13	[illegible]	09	96	30	102	13	100	30	104
702	1000	63	76	15	78	15	79	18	[illegible]	17	87	08	78
	1200	59	[illegible]	13	[illegible]	12	[illegible]	18	101	13	[illegible]	08	82
	1400	34	[illegible]	09	100	07	100	25	85	12	[illegible]	07	82
	1600	26	[illegible]	08	[illegible]	07	[illegible]	25	[illegible]	18	82	17	75
	1800	25	102	09	102	06	102	40	92	26	78	12	70
	2000	19	[illegible]	05	100	06	100	60	72	34	[illegible]	39	[illegible]

TABLE 11. LSN INJECTOR SETTINGS, FIRST INTERIM INSPECTION
(As Received from Field Operation)

Bus 707 (26,650 mi)

Engine Bank	Cylinder No.	Injector Setting	Change Since Initial Inspection
Left	1	1.483	+0.013
Left	2	1.490	+0.020
Left	3	1.474	+0.004
Right	4	1.471	+0.001
Right	5	1.479	+0.009
Right	6	1.474	+0.004

Bus 704 (25,193 mi)

Engine Bank	Cylinder No.	Injector Setting	Change Since Initial Inspection
Left	1	1.474	+0.004
Left	2	1.472	+0.002
Left	3	1.474	+0.004
Right	4	1.472	+0.002
Right	5	1.474	+0.004
Right	6	1.472	+0.002

Bus 702 (22,962 mi)

Engine Bank	Cylinder No.	Injector Setting	Change Since Initial Inspection
Left	1	1.473	+0.003
Left	2	1.474	+0.004
Left	3	1.474	+0.004
Right	4	1.472	+0.002
Right	5	1.470	---
Right	6	1.475	+0.005

1. Odor Run Data

Simultaneous with odor panel measurements made during the 4 steady state conditions, CO, HC, NO, aldehydes, formaldehyde, and acrolein were measured. The results, averages of the four replications in random order, are presented in Tables 12, 13, and 14 for Buses 702, 704, and 707, respectively. Though the LSN injectors make dramatic cuts in hydrocarbons, the catalytic muffler had substantially less effect, if any. This same conclusion is clear from the carbon monoxide measurements. The amount of reduction seems less than for HC but this is because there is very little CO in diesel exhaust to start with. The third major emission of interest from internal combustion engines, nitric oxide, was slightly increased by the application of the EIP kit. The increase of about 15 percent overall may be attributed directly to the action of the improved injectors in making combustion more efficient. On several instances, slight increases in NO were found with the catalytic muffler, but, on the whole, the catalyst had no real effect one way or the other. More on HC, CO, and NO will be included later.

Formaldehyde, aliphatic aldehydes, and acrolein, three partially oxygenated materials which among other items have been related to odor, are also listed on Tables 12, 13, and 14. Consistent reductions in all three components were found at the initial and first interim inspection. The U_a statistic indicated most data points to be statistically significant reductions. The only exception was formaldehyde in Bus 702 at the initial inspection, and the reason for this is unknown at this time. Comparing the LSN to the LSN with catalytic muffler results, it is obvious that the catalyst was ineffective in further reducing oxygenates. More detailed results of these tests may be found in the tables included in Appendix C to this report.

2. Cyclic Data

Table 15 is a brief summary of the 13-mode cyclic test for HC, CO, and NO. The procedure is a special city bus modification to the EMA 13-mode schedule and the results are expressed in terms of grams per flywheel brake horsepower-hour (g/bhp-hr). As in the previous paragraphs, the catalytic muffler demonstrated no effectiveness in reducing these three emissions. The LSN injectors did effect a gross change in brake specific hydrocarbons on the order of 80- to 90-percent reduction, while reductions in CO were on the order of 40 to 60 percent. Bus 707 did not respond the same and showed essentially no change in CO. Nitric oxide was increased 10 to 15 percent by the LSN injectors except for Bus 707 and 702 at the first interim inspection where a negligible change was measured.

The HC and NO, expressed as NO_2, results are illustrated by the bar charts in Figure 36, initial, and Figure 37, first interim inspection. In both figures, the HC is stacked on top of the brake specific NO_2 emissions

TABLE 12. OVERALL SUMMARY OF GASEOUS EMISSIONS MEASURED DURING ODOR TESTS, TWO-YEAR FLEET TEST OF EM-EIP KIT
(Bus 702)

[illegible]

TABLE 11. OVERALL SUMMARY OF GASEOUS EMISSIONS MEASURED DURING ODOR TESTS, TWO-YEAR FLEET TEST OF GM-EEP KIT

(Bus 704)

TABLE 14. OVERALL SUMMARY OF GASEOUS EMISSIONS MEASURED DURING ODOR TESTS, TWO-YEAR FLEET TEST OF GM-EEP KIT

(Bus 707)

TABLE 15. OVERALL SUMMARY OF GASEOUS EMISSIONS DURING CYCLIC TEST, TWO-YEAR FLEET TEST OF GM-EIP KIT

Car No.	Test Miles	Engine Hours	Test Date	Test Configuration	HC, g/mile Modification		CO, g/mile Modification		NOx, g/mile Modification	
					EIP	EIP+Cat	EIP	EIP+Cat	EIP	EIP+Cat
707	912	99	9/4/70 9/2, 8/28/70	Stock, 5 Modification Net Change	8.24 1.02 −7.22	8.24 0.81 −7.43	6.17 6.39 +0.22	6.17 4.54 −1.63	8.17 9.25 +0.92	8.31 10.39 +1.99
706	1,073	99	9/30/70 9/26, 9/11/70	Stock, 5 Modification Net Change	9.30 1.46 −7.84	9.30 1.18 −8.12	8.42 5.40 −3.02	8.42 3.82 −4.59	7.22 8.65 +1.43	7.22 7.85 +0.63
702	1,259	142	10/2/70 9/30, 9/25/70	Stock, 5 Modification Net Change	9.10 1.94 −7.16	9.10 1.64 −7.46	7.51 2.92 −4.59	7.51 2.96 −4.55	8.31 9.47 +1.16	8.31 8.57 +0.26
First Interim Inspection										
707	26,680	1,970	4/2/71 4/1, 3/29/71	Stock, 5 Modification Net Change	10.71 1.24 −9.47	10.71 1.13 −9.58	6.46 6.42 −0.04	6.46 6.72 +0.26	7.95 7.89 −0.06	7.95 8.12 +0.17
706	23,190	2,065	4/16/71 4/15, 4/12/71	Stock, 5 Modification Net Change	11.51 1.49 −10.02	11.51 1.60 −9.91	6.98 4.59 −2.39	6.98 5.52 −1.46	6.61 7.91 +1.30	6.61 7.91 +1.30
702	22,962	1,721	4/30/71 4/29, 4/26/71	Stock, 5 Modification Net Change	16.77 1.17 −15.60	16.77 1.29 −15.48	5.86 3.64 −2.22	5.86 4.07 −1.79	6.89 6.95 +0.06	6.89 7.16 +0.27

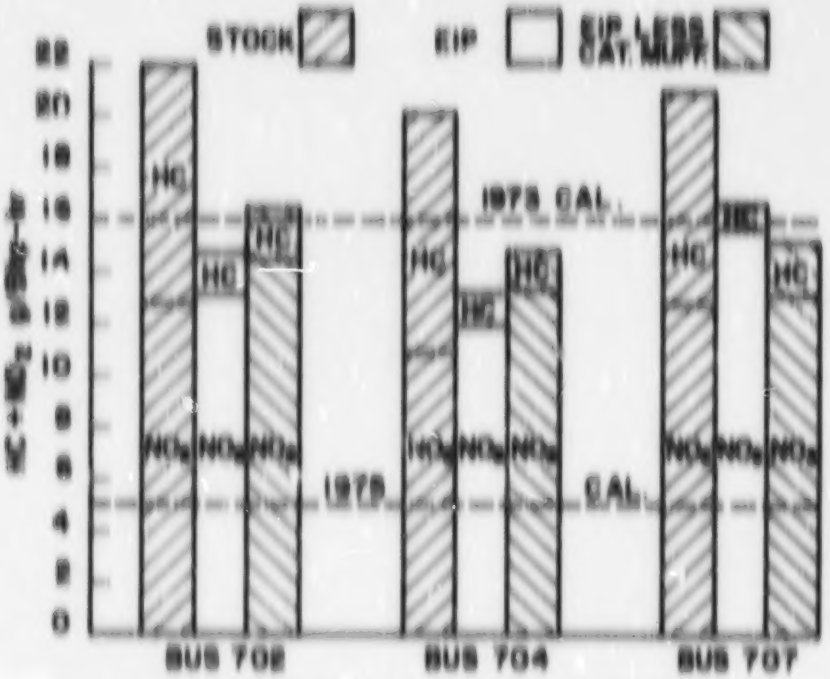


FIGURE 36. EIP VS STOCK HC + NO_2--11 MODE--INITIAL

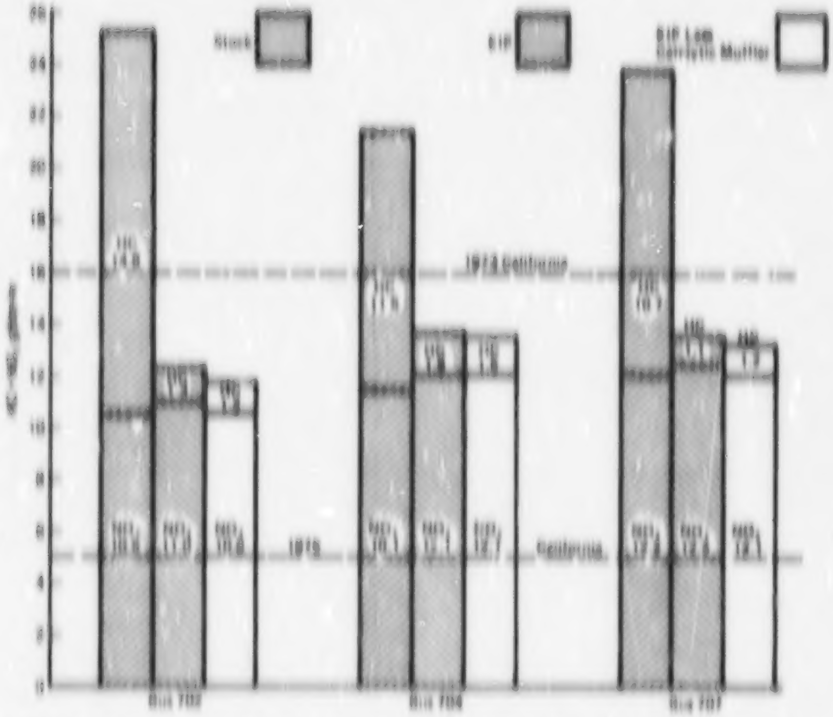


FIGURE 37. EIP VS STOCK HC + NO_2--11 MODE--FIRST INTERIM INSPECTION

(NO x 46/30) *for* comparison to 1973 and 1975 California standards of 16 and 5 g/bhp-hr, respectively. Though the EIP-equipped, or LSN injector-equipped, 6V-71E type (low compression) bus engine appears to meet the 1973 standard, it remains to be seen whether the 1975 standard is possible. Even if hydrocarbons could be further reduced, say to almost zero, the 1975 standards will be out of reach without a severe cut of NO_2.

Complete mode-by-mode gaseous emissions results for the 13-mode schedule are contained in Appendix C of this report. As an example of how these data could be used, mode-wise emission rates, on a grams per hour basis, have been computed and are listed in Tables 16, 17, and 18 for HC, CO, and NO, respectively. These data are helpful in determining which mode or modes are more responsible for emission than others and could be graphed versus power level for both operating speeds. Another method of analysis would be to compute the emissions in terms of grams per pound of fuel consumed. This form may be helpful in determining national impact since fuel consumption in city buses is published. The only difficult part would be to determine the proper bus-use factor for weighting of the various modes. This analysis is beyond the intent of this project.

D. General Operation

Contained in this subsection are the other measurements made during and as a part of this field demonstration to date.

1. Pressures and Temperatures

Table 19 is a summary of the inlet and outlet temperatures, pressures, and the pressure drop and temperature change across the catalytic muffler and stock unit for comparison. The pressure drops were substantially higher with the catalytic muffler than the stock muffler under all conditions for all buses at both inspections. The pressure drop was essentially the same at both inspections indicating the catalyst bed was not clogging, packing, sintering, or sticking in the muffler and that the exhaust gases were not more restricted after about 25,000 miles than when the units had been in operation for 1000 miles. The restriction imposed by the catalytic muffler is still less than the maximum allowed by the manufacturer.

The temperature change, the inlet gas minus the outlet gas temperature, gave no conclusive indication of catalyst activity. Sometimes the change was slightly more or less than the stock unit and no clear trend was evident from an analysis of conditions, buses, or inspection periods. One interesting point, found during tests of this type muffler several years ago, was the increase in temperature of the catalytic muffler exit gases during idle. This is not from the activity of the catalyst but is attributed to the heat stored in the 40 lb of charge within the muffler during the previous

TABLE 16. SUMMARY OF MODE BY MODE HYDROCARBON EMISSIONS, g/hr DURING CYCLIC TESTS, TWO-YEAR FLEET TEST OF GM-EIP KIT

Mode No.	Engine Speed, rpm	Load, %	Initial Inspection Test Configuration			First Interim Inspection Test Configuration		
			S, Stack	EIP, Stack	EIP, Cat	S, Stack	EIP, Stack	EIP, Cat
Bus 707								
1	550	0	123.9	27.3	20.7	156.0	27.5	30.4
2	1000	0	264.5	46.8	34.1	336.7	31.7	47.3
3	1000	25	427.7	47.0	37.8	549.8	47.8	53.7
4	1000	50	404.9	53.6	36.2	459.4	49.9	56.4
5	1000	75	393.9	50.6	46.6	499.3	63.9	65.3
6	1000	100	437.8	59.1	41.8	512.0	71.3	74.6
7	550	0	121.6	26.3	17.1	167.5	30.3	28.8
8	1600	100	616.4	61.0	39.7	770.2	100.7	86.0
9	1600	75	586.7	68.4	38.8	780.3	88.7	76.7
10	1600	50	549.3	62.3	46.9	778.5	80.0	67.8
11	1600	25	678.8	64.9	78.0	971.3	73.9	65.2
12	1600	0	697.7	65.1	70.9	961.0	71.2	62.1
13	550	0	118.1	36.5	30.6	169.8	37.3	33.1
Bus 708								
1	550	0	143.4	37.6	29.5	160.5	41.6	34.3
2	1000	0	334.2	63.0	49.9	382.1	56.0	56.4
3	1000	25	412.4	50.8	51.8	534.3	54.4	68.0
4	1000	50	485.3	61.0	53.2	670.9	56.1	75.1
5	1000	75	442.9	59.1	55.2	587.3	68.1	91.3
6	1000	100	445.0	78.6	68.3	574.4	85.3	91.8
7	550	0	137.9	32.6	22.6	148.7	36.2	23.1
8	1600	100	613.9	96.0	78.6	801.2	122.5	130.1
9	1600	75	643.3	87.6	67.8	878.9	108.9	109.6
10	1600	50	631.2	84.0	73.2	879.4	98.0	93.9
11	1600	25	711.4	84.3	78.0	985.0	85.1	88.2
12	1600	0	675.5	88.6	81.3	970.3	83.2	88.2
13	550	0	134.3	33.4	38.5	146.5	16.4	31.1
Bus 707								
1	550	0	118.6	48.1	36.5	167.2	28.9	23.6
2	1000	0	295.3	73.4	63.7	377.6	44.0	40.3
3	1000	25	492.7	67.1	67.5	643.6	39.0	46.8
4	1000	50	508.4	67.7	67.6	791.8	42.6	51.4
5	1000	75	459.1	773	74.1	639.6	56.8	65.5
6	1000	100	429.5	93.5	76.4	607.9	58.7	67.7
7	550	0	106.9	46.1	34.3	161.9	28.8	26.6
8	1600	100	639.0	130.2	106.6	891.7	93.4	91.4
9	1600	75	701.9	116.6	89.3	1031.2	74.5	67.6
10	1600	50	703.1	113.3	91.5	1027.4	66.8	67.9
11	1600	25	773.6	118.3	99.1	1187.0	62.0	68.1
12	1600	0	774.2	116.0	103.0	1261.3	62.8	68.1
13	550	0	106.5	40.0	37.3	153.3	37.7	37.7

TABLE 17. SUMMARY OF MODE BY MODE CARBON MONOXIDE EMISSIONS, g/hr DURING CYCLIC TESTS, TWO-YEAR FLEET TEST OF GM-EIP KIT

Mode No.	Engine Speed, rpm	Load, %	Initial Inspection Test Configuration			First Interim Inspection Test Configuration		
			S, Stack	LSN, Stack	LSN, Cat	S, Stack	LSN, Stack	LSN, Cat
				Bus 707				
1	550	0	57.2	52.7	36.3	75.0	41.8	50.4
2	1000	0	90.6	77.0	64.0	110.1	65.7	64.6
3	1000	25	77.3	51.4	38.4	96.9	17.6	41.7
4	1000	50	77.7	45.1	35.6	100.8	17.0	48.3
5	1000	75	117.0	71.7	109.5	179.9	194.7	125.4
6	1000	100	2020.3	2747.9	1846.2	2049.7	3602.0	2721.5
7	550	0	48.5	48.5	28.7	67.8	36.8	47.0
8	1600	100	1001.1	726.9	426.9	1018.4	657.8	955.0
9	1600	75	128.7	75.6	64.5	139.5	17.4	97.5
10	1600	50	107.6	51.3	42.4	104.0	20.7	51.4
11	1600	25	128.6	74.6	42.3	120.3	28.6	39.6
12	1600	0	128.9	64.0	71.5	126.0	40.0	45.3
13	550	0	46.8	44.4	13.2	65.1	30.2	47.8
				Bus 704				
1	550	0	73.8	76.1	61.2	87.5	61.0	69.4
2	1000	0	164.7	145.2	103.6	173.1	99.5	102.4
3	1000	25	118.1	71.7	93.9	108.5	44.7	66.1
4	1000	50	119.1	53.2	51.6	83.1	17.7	61.5
5	1000	75	188.0	93.6	84.9	192.1	118.4	163.2
6	1000	100	2330.7	3039.1	1212.3	2294.2	1829.3	1877.0
7	550	0	65.0	61.1	52.9	67.5	47.1	58.9
8	1600	100	1475.4	434.3	356.5	1185.4	446.3	485.1
9	1600	75	143.1	63.1	85.9	102.1	19.8	95.9
10	1600	50	142.0	64.9	64.1	74.4	17.3	62.0
11	1600	25	161.6	64.6	85.6	121.8	14.4	73.4
12	1600	0	174.8	56.7	86.2	125.8	14.4	72.8
13	550	0	61.9	33.8	57.0	61.2	45.3	47.3
				Bus 707				
1	550	0	80.9	74.0	69.8	63.3	47.5	49.6
2	1000	0	170.5	117.9	124.1	119.6	88.7	86.8
3	1000	25	139.3	71.1	64.6	92.6	46.1	51.0
4	1000	50	117.2	31.8	51.7	82.7	27.1	41.1
5	1000	75	434.0	38.6	51.9	150.3	97.3	121.9
6	1000	100	3005.2	688.7	720.9	1939.5	1181.6	1307.6
7	550	0	72.0	61.1	48.7	59.0	38.8	45.0
8	1600	100	726.6	188.2	209.4	428.1	130.9	113.4
9	1600	75	168.2	76.0	75.1	110.0	28.8	50.8
10	1600	50	160.9	64.8	64.2	91.8	17.3	28.8
11	1600	25	208.9	86.4	85.7	125.8	28.6	45.7
12	1600	0	208.6	86.6	86.0	120.0	23.7	19.8
13	550	0	77.0	56.8	53.9	43.0	12.1	36.3

TABLE 18. SUMMARY OF MODE BY MODE NITRIC OXIDE EMISSIONS, g/hr DURING CYCLIC TESTS, TWO-YEAR FLEET TEST OF GM EIP KIT

Mode No.	Engine Speed, rpm	Load, %	Initial Inspection Test Configuration			First In-terim Inspection Test Configuration		
			S. Stack	LSN, Stack	LSN, Cat	S. Stack	LSN, Stack	LSN, Cat
Bus 707								
1	550	0	62.5	89.9	96.7	67.9	86.2	84.7
2	1000	0	99.5	131.1	143.6	114.6	115.3	133.7
3	1000	25	261.1	268.8	293.8	236.1	223.8	228.9
4	1000	50	377.5	398.7	441.0	355.5	367.9	373.3
5	1000	75	583.0	633.9	732.0	523.7	531.3	541.5
6	1000	100	666.1	674.6	708.7	570.9	508.1	533.9
7	550	0	78.2	105.8	120.1	79.3	92.9	96.9
8	1600	100	1164.8	1245.1	1312.3	1061.7	983.5	1029.3
9	1600	75	850.1	1023.6	1094.0	850.2	814.4	867.6
10	1600	50	566.1	606.4	716.6	592.1	560.0	560.5
11	1600	25	305.9	330.9	421.9	349.1	349.4	379.6
12	1600	0	151.4	177.1	480.1	143.5	128.5	165.1
13	550	0	76.0	94.1	101.6	70.5	87.5	96.9
Bus 704								
1	550	0	64.9	90.1	71.6	47.9	67.5	64.4
2	1000	0	86.1	111.3	106.2	76.1	105.0	107.4
3	1000	25	177.7	244.9	173.8	186.1	238.4	215.1
4	1000	50	314.9	356.7	367.8	305.0	361.8	336.8
5	1000	75	496.3	491.1	539.0	495.1	495.1	563.0
6	1000	100	551.5	620.5	636.9	508.6	540.7	524.1
7	550	0	73.3	89.8	93.0	57.4	68.5	73.8
8	1600	100	996.3	1008.2	932.1	927.3	934.6	910.4
9	1600	75	691.1	811.0	726.2	692.3	808.7	794.7
10	1600	50	653.3	671.8	677.1	665.9	637.2	651.3
11	1600	25	321.7	361.2	293.6	288.8	321.0	331.2
12	1600	0	286.0	169.4	167.1	283.7	298.8	153.1
13	550	0	71.3	89.6	80.4	59.4	66.1	79.6
Bus 702								
1	550	0	67.4	62.5	62.9	49.1	49.4	49.4
2	1000	0	96.8	100.2	93.2	94.6	86.7	92.0
3	1000	25	220.7	242.7	[illegible]	172.8	191.6	183.0
4	1000	50	364.1	[illegible]	312.2	308.0	387.6	363.2
5	1000	75	563.4	531.1	490.1	513.7	469.1	461.8
6	1000	100	607.0	687.6	562.4	496.1	518.2	486.6
7	550	0	80.5	91.7	80.7	56.4	56.7	61.3
8	1600	100	1030.9	1052.7	975.2	857.3	767.6	780.6
9	1600	75	859.2	873.0	736.5	650.7	656.1	673.4
10	1600	50	534.1	594.3	532.4	443.6	622.7	607.6
11	1600	25	310.0	373.3	122.3	369.1	371.9	370.2
12	1600	0	307.2	161.6	388.7	384.6	293.5	384.4
13	550	0	78.0	96.1	83.1	36.4	38.6	61.4

TABLE 13. CATALYTIC MUFFLER INLET/OUTLET TEMPERATURES AND PRESSURES, TWO-YEAR FLEET TEST OF GM-EIP KIT

Operating Condition	Car No.	Test Miles	Engine Hours	Test Date		Pressure, in. H₂O						Temperature, °F					
						Inlet		Outlet		Drop		Inlet		Outlet		Difference	
				Stock	Cat.	Stock	Cat.	Stock	Cat.	Stock	Cat.	Stock	Cat.	Stock	Cat.	Stock	Cat.
24 mph 900 rpm 17 in. Hg	707	911	99	9/1	8/31	8	11	5	7	3	4	485	510	345	445	140	65
	706	1,077	98	9/15	9/24	8	11	6	4	2	7	460	505	330	320	130	180
	702	1,730	142	10/1	9/20	8	10.5	5	6.5	3	4	470	480	350	295	120	185
	707	26,659	1,971	3/23/71	3/30/71	7	11	6	6	1	5	430	345	300	300	130	45
	706	23,195	2,065	4/16/71	4/22/71	10	15	8	7	2	8	330	460	310	210	200	250
	702	22,962	1,721	4/20/71	4/27/71	9	12	7	6	2	nil	475	480	325	275	150	205
32 mph 1200 rpm 17 in. Hg	707	911	95	8/31	9/1	13	17	9	10	4	7	505	550	350	410	150	140
	706	1,077	98	9/15	9/24	14	22	9	9	5	13	480	520	325	365	155	225
	702	1,730	142	10/1	9/20	14	20	9	8	5	12	535	485	375	325	160	160
	707	26,659	1,971	3/23/71	3/30/71	15	21	12	12	3	9	375	560	330	310	205	250
	706	23,195	2,065	4/16/71	4/22/71	20	25	16	11	4	14	525	580	345	300	180	280
	702	22,962	1,721	4/20/71	4/27/71	15	23	12	12.5	3	11	480	505	355	305	125	120
40 mph 1500 rpm 17 in. Hg	707	911	99	9/1	8/31	21	30	15	20	7	12	565	620	365	525	200	95
	706	1,077	98	9/15	9/24	22	36	15	15	7	21	560	565	370	380	190	185
	702	1,730	142	10/1	9/20	26	32	16	15	8	15	575	550	400	375	165	155
	707	26,659	1,971	3/23/71	3/30/71	26	33	20	17	6	13	585	550	370	385	215	165
	706	23,195	2,065	4/16/71	4/22/71	27	39	22	19	4	20	560	510	360	330	200	180
	702	22,962	1,721	4/20/71	4/27/71	25	36	17	19	6	19	540	545	360	360	180	185
Idle	707	911	99	9/1	8/31	4	4	2	2	2	2	280	260	240	330	40	−80
	706	1,077	98	9/15	9/24	3	4	2	2	1	2	270	260	235	330	35	−70
	702	1,730	137	10/1	9/20	3	3.5	2	1.5	1	2	270	260	295	300	45	−40
	707	26,659	1,971	3/23/71	3/30/71	1	4	2	2	0	2	285	260	285	270	0	−10
	706	23,195	2,065	4/16/71	4/22/71	2	4	2	2	0	2	320	280	310	310	10	−30
	702	22,962	1,721	4/20/71	4/27/71	2.0	3.0	1.5	1.5	0.5	1.5	295	290	290	270	5	−20

running condition. When the cooler idle exhaust enters the muffler, heat is transferred to the gas and the muffler cools down.

Table 20 lists pertinent air box and exhaust restrictions taken at both inspections at 1200, 1800, and 2100 rpm with the transmission in neutral. The inlet air restrictions are well below the manufacturers, allowable and stayed nearly the same during the test for all units. Air box pressures likewise were stable and were only slightly higher for the EIP (catalytic muffler) than the stock configuration. Exhaust back pressure was twice that of the stock muffler when the catalytic muffler was employed. The air box and exhaust back pressures are not considered excessive.

2. Mileage and Maintenance

Table 21 summarizes operating data for the three buses during the first period of operation on a bimonthly basis as far as miles and hours of operation, fuel and oil consumption, and number of days operated. Miles operated per test period dropped off after period 9 at SwRI request. This was necessary to keep the fleet from accumulating an excessive amount over the planned 20,000 miles for the first interim inspection. Delays in authorization of the contract modification resulted in a mileage stretch-out for about two months in which buses were operated on a minimum mileage per day basis and were not operated every day.

Listed at the bottom of Table 21 are the overall miles per hour, day, week, and month, and the fuel and oil consumption rates as of April 30, 1971. Comparison of these results indicates little difference between Buses 702 and 704. The Bus 707 mileage accumulation rate is slightly higher, while fuel consumption, in miles/gallon, was slightly lower. Bus 707 is using less oil and slightly less fuel.

Maintenance performed to the EIP kit involved replacement of the vertical exhaust pipe fiberglas shroud on Bus 702 on September 9, 1970, which was ripped off by the automatic washing machine and damaged beyond repair. Repair and repainting of the exhaust shroud on Bus 702 on March 30, 1971 (1963 hr) and replacement of the rubber channel around the rear glass adjacent to the vertical stack were also necessary. The rubber was brittle due to apparent heat damage from the vertical exhaust pipe. No other maintenance was performed on the EIP kits on the three buses as of April 30, 1971. Other than routine, scheduled, preventative maintenance to the engine such as oil change, filter replacement, etc., no engine maintenance was performed that would affect exhaust emissions.

Approximately [illegible] hour of labor was expended in replacing the exhaust shroud, and the part was furnished at no charge by the manufacturer. Repair and repainting of Bus 702 on March 30, 1971, involved 14 hr of labor.

TABLE 20. AIR BOX, INLET, AND EXHAUST PRESSURES UNDER NO-LOAD CONDITIONS, TWO-YEAR FLEET TEST OF GM-EIP KIT

Bus No.	Test Miles	Engine Hours	Test Date	Test Configuration	Pressures at rpm								
					Inlet, in. H₂O Vac			Air Box, in. Hg			Exhaust, in. Hg		
					1200	1800	2100	1200	1800	2100	1200	1800	2100
707	911	46	8/22/78 9/4/78	EIP Stock	17 17	38 37	50 48	44 39	104 96	145 140	136 85	239 88	335 32
704	1,075	48	9/18/78 9/19/78	EIP Stock	15 15	36 35	49 46	40 33	104 84	150 119	849 641	235 111	330 187
702	1,759	142	9/26/78 10/2/78	EIP Stock	14 15	32 32	42 44	34 37	87 94	125 116	895 640	224 121	320 130
First Interim Inspection													
707	26,650	1,570	3/29/79 3/31/79	EIP Stock	31 26	64 55	83 73	37 305	91 725	128 102	890 831	227 129	327 123
704	25,195	2,065	4/12/79 4/14/79	EIP Stock	36 32	86 78	120 92	33 32	87 86	123 122	10 646	245 117	37 176
702	22,962	1,720	4/26/79 4/28/79	EIP Stock	20 21	44 47	575 61	38 35	88 865	123 126	19 836	246 842	342 137

TABLE 21. GENERAL OPERATING DATA—TWO YEAR FLEET TEST ON GM-EIP KIT

Test No.	Test Period	[illegible]					[illegible]					[illegible]				
		Miles	Hours	Fuel, gal	Oil, qt	Days	Miles	Hours	Fuel, gal	Oil, qt	Days	Miles	Hours	Fuel, gal	Oil, qt	Days
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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The enlarged air cleaner paper element, a part of the EIP inlet air system, will require replacement periodically. Insufficient information is available at this time to determine if this cost will be greater than normal maintenance.

V. COST-EFFECTIVENESS

This is an interim report, and a rigorous cost-effectiveness appraisal is not desired nor possible at this time. Some general observations can and should be made.

A. Noise Items

It is uncertain whether the amount of noise reduction afforded by the EIP kit is sufficient to warrant these items. Only the interior noise levels were affected and, in comparison to cutting off the air conditioner on the buses evaluated, the noise reduction seemed moderate. To make the kit more effective from an interior noise standpoint, at least on units with the type factory-installed air conditioner used by San Antonio Transit on these three units, provision for air-conditioner noise reduction seems appropriate.

The interior noise reduction, claimed by manufacturer and confirmed by this test, appeared somewhat offset by an increase in the exterior noise level. The EIP-recommended upshift speed will likely raise the upshift point of many city buses and result in higher engine speeds and attendant sound level. The higher engine speeds may be found to be an annoyance, especially in residential houses and apartments early in the morning and at night.

In this regard, the electromechanical transmission governor for setting upshift-downshift points, of the type used in the three San Antonio Transit System buses, should be replaced by an improved unit as part of the EIP kit. The field and laboratory experience gained in operation of these type units, both new and rebuilt, illustrated their inability to be dependable in holding the precise set points needed for EIP operation. The effectiveness of this type governor is judged below the standards necessary for maintenance of desired shift points. It was most difficult to set originally and drifted down during the initial 25,000 miles of test. Not all buses for which the EIP kit is intended employ this particular electromechanical governor. The EIP kit should, for those buses so equipped with old style electromechanical governors, include an improved, more reliable, and easier to adjust transmission governor. If not, some of the improvements claimed for the kit by raising upshift and downshift speeds will be reduced should, for example, the downshift point drift down by 100 to 200 rpm. Finally, the vertical stack moves the exhaust gas noise from streetside bumper level to a less noticeable streetside but vertical orientation above ear height.

B. Catalytic Muffler

Though this 2-year demonstration is far from complete, little can be reported for the catalytic muffler used in the EIP kit. Generally, the effectiveness on odor, smoke, and gaseous emissions has varied slightly on both sides of zero, and consistent, significant trends in reduced emissions have not been demonstrated on the three units tested so far. It is not possible to compute a ratio of cost to effectiveness when the denominator is essentially zero.

The test of initially installed mufflers is about half done as the catalyst should be replaced by a new 40-lb charge after 40,000 miles (according to the manufacturer). The cost of the catalyst is $2.77 per lb (2/23/71 price).

The claim that the catalyst serves to reduce emissions from an engine that has not received proper maintenance or adjustment has not been shown so far. For example, Bus 707, with two injectors that have become substantially out of adjustment, showed essentially the same emissions when the catalytic muffler was used as when the LSN injectors were employed. This is one example and, as the test progresses, the catalyst will have an increasing number of opportunities to correct emissions increases due to engine-injector deterioration.

C. Vertical Stack

There is no doubt that the vertical stack makes the odor less noticeable by directing it up and diluting it more before it is experienced by persons at street level. Whether the vertical stack is an acceptable control method for odor is debatable at this point since control of smoke, another nuisance emission, does not recognize dilution effects, i.e., give vertical stacks a greater dilution ratio than horizontal. The determination of the amount of dilution from a vertical stack-equipped city bus (EIP item) has never been determined under driving conditions, though a static idle condition was investigated by General Motors Research and reported on in Reference 8. If dispersing and diluting the exhaust odor is considered an acceptable control method, then the effect is probably large relative to the cost and the vertical stack enjoys an attractive cost-effectiveness ratio. The one disadvantage cited by many is the need for zero visibility exhaust. Many in the coach business feel that the vertical stack will draw more attention to the bus if the exhaust is visible. This point remains to be seen as many truck manufacturers and fleet operators feel otherwise and favor vertical exhaust where smoke is equal (and noticeable).

D. LSN Injectors

There is little doubt that the LSN injectors are responsible for major reductions in odor, smoke, and other gaseous emissions while resulting in slightly more nitric oxide. This conclusion was made over 18 months ago and still stands. Shortly thereafter, the San Antonio Transit System began a program of replacement of S injectors by needle injectors and, as the LSN became commercially available, the improved injector parts were obtained.

Replacement of injectors is made when injectors are normally removed for overhaul. Instead of replacing a worn out S with a rebuilt S, the San Antonio Transit System obtains from Weber Diesel Service a rebuilt unit with the LSN injector features. The cost, as of March 9, 1971, on a straight exchange basis, is $32.00 per LSN injector with new LSN tip. A new injector obtained from GM is $58.33 (4/9/71 price). The out-of-pocket cost is less than $32.00 per injector since the injector had to be replaced anyway and the net cost increase to obtain an LSN instead of a rebuilt S from Weber Diesel Service is $19.50 ($32.00 less $12.50 for rebuilt S with used S exchange or "core"). For a 6-cylinder engine, the net cost per bus, on a normal replacement basis, is $117.00. This results in one of the best cost-effectiveness ratios yet. The numerator of the ratio is near zero and the effectiveness is substantial.

If injectors were replaced on a campaign basis, then both injector costs, i.e., $32.00 rebuilt or $58.33 new, $192.00 and $349.98 per six-cylinder engine, plus about 5-1/2 hr labor, at say $8.00/hr or $44.00, represent the cost per bus. This cost still results in a most attractive proposition relative to the significant effectiveness achieved to warrant immediate retrofit of all engines with these improved injectors. Though the field demonstration has over 1 year to go, the durability of LSN injectors is considered as good as the S or N injectors. Incidentally, all new engines manufactured by Detroit Diesel Division for truck and bus application are equipped with the LSN injectors beginning with the calendar year 1970 Federal smoke certified engine program. These injectors would not be used in normal production if their durability was questioned. Further delays in the use of these injectors in older style buses equipped with S injectors are not justified. Improvements by the LSN relative to the N injector are not substantial (see Ref. 4) and therefore the cost-effectiveness ratio will not be nearly as attractive.

To keep the LSN injectors performing as intended, more frequent adjustment of injector settings is recommended. A twice yearly schedule could net large benefits in maintaining low smoke levels. Using the factory-recommended dial indicator adjustment tool (cost approximately $75.00) the check and adjustment of injectors beyond, for example, 1.475 would take about 2-1/2 hr. Bus 707 illustrated how two injectors could change in adjustment with just 25,000 miles of operation, a change sufficient to negate the smoke improvements of the improved injector.

VI. EFFECT ON PUBLIC AWARENESS

The major intent of the EIP kit is to eliminate or reduce as far as possible the city bus as a factor in public annoyance. Noise, vibration, smoke, and odor have been the targets which, in the levels or concentrations experienced with uncontrolled buses, do not result in a health problem but are associated with public welfare. Except for nitric oxide, the diesel engine used in most city buses emits significantly small quantities of carbon monoxide and hydrocarbons relative to the gasoline engine. Some major items in the EIP kit address only the public awareness problem. The vertical stack is one such item, designed and employed to turn the exhaust noise and odor up and away from most observers.

The question must then be asked, will the EIP kit affect the annoyance to the public of city buses and thereby reduce complaints?

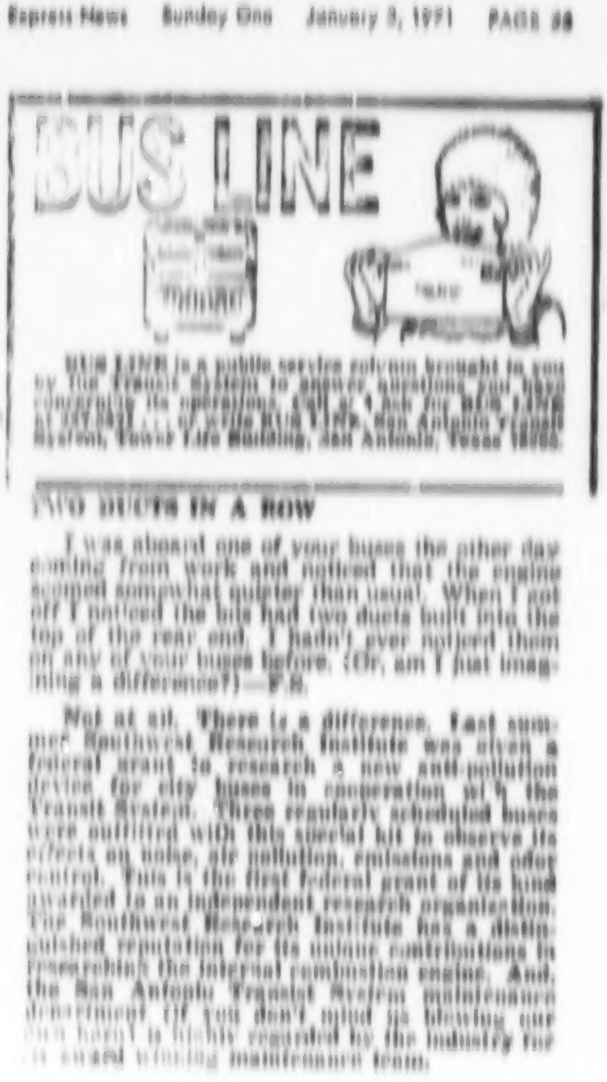
A. Noise

Interior noise reductions should be noticed especially in winter when the air conditioner is inoperative. Exterior noise reductions will be offset somewhat by increased engine speed during acceleration to upshift, a repeated condition. Depending on how much increase is made in a particular fleet, i.e., what the local population is accustomed to, the exterior noise factor could increase. Incidentally, exterior noise affects more people per day than does interior noise. And, people within a bus are there for the purpose of transportation and expect some noise and vibration, whereas the community population may infrequently or never ride public transporation yet have no recourse but to be exposed to its noise.

Several nice comments have been made by bus patrons regarding the decreased interior noise in the EIP-equipped buses. No specific comments have been received about exterior noise. However, this lack of comment may be tempered somewhat by the fact that only three out of several hundred San Antonio Transit buses are so equipped and a deterioration in upshift-downshift speeds can be expected to occur with time. One remark, published in a weekly column appearing in the San Antonio Express newspaper, is reprinted as an example of public concern.

B. Odor

The odor from diesel-powered city buses is probably the best studied diesel engine emission next to smoke. In some respects, it is more completely known about, specifically its public objectionability. In a separate, but companion EPA project to this long-range investigation of diesel emissions, of which EIP demonstration is a part, studies have been made of public opinion of dilute samples of diesel, bus-like odor. References 6 and 7 are suggested



Express News   Sunday One   January 3, 1971   PAGE 38

BUS LINE

BUS LINE is a public service column brought to you by The Transit System to answer questions you have concerning its operations. [illegible] BUS LINE [illegible] San Antonio Transit System, Tower Life Building, San Antonio, Texas 78205.

TWO DUCTS IN A ROW

I was aboard one of your buses the other day coming from work and noticed that the engine sounded somewhat quieter than usual. When I got off I noticed the bus had two ducts built into the top of the rear end. I hadn't ever noticed them on any of your buses before. (Or, am I just imagining a difference?)—F.R.

Not at all. There is a difference. Last summer Southwest Research Institute was given a federal grant to research a new anti-pollution device for city buses in cooperation with the Transit System. Three regularly scheduled buses were outfitted with this special kit to observe its effects on noise, air pollution, emissions and odor control. This is the first federal grant of its kind awarded to an independent research organization. The Southwest Research Institute has a distinguished reputation for its unique contributions in researching the internal combustion engine. And, the San Antonio Transit System maintenance department (if you don't mind us blowing our own horn) is highly regarded by the industry for its award winning maintenance team.

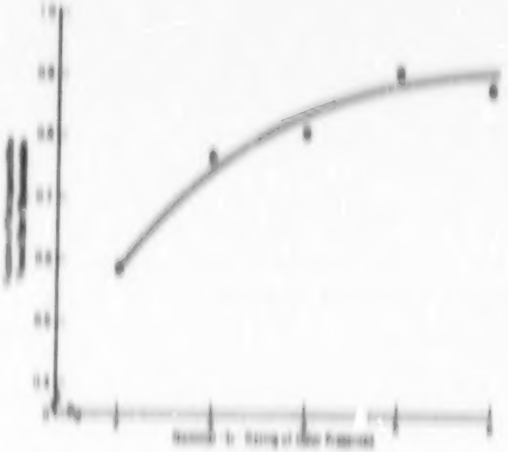


FIGURE 38. ODOR DOSE--PUBLIC RESPONSE TO BUS-LIKE DIESEL EXHAUST ODOR (Reference 7)

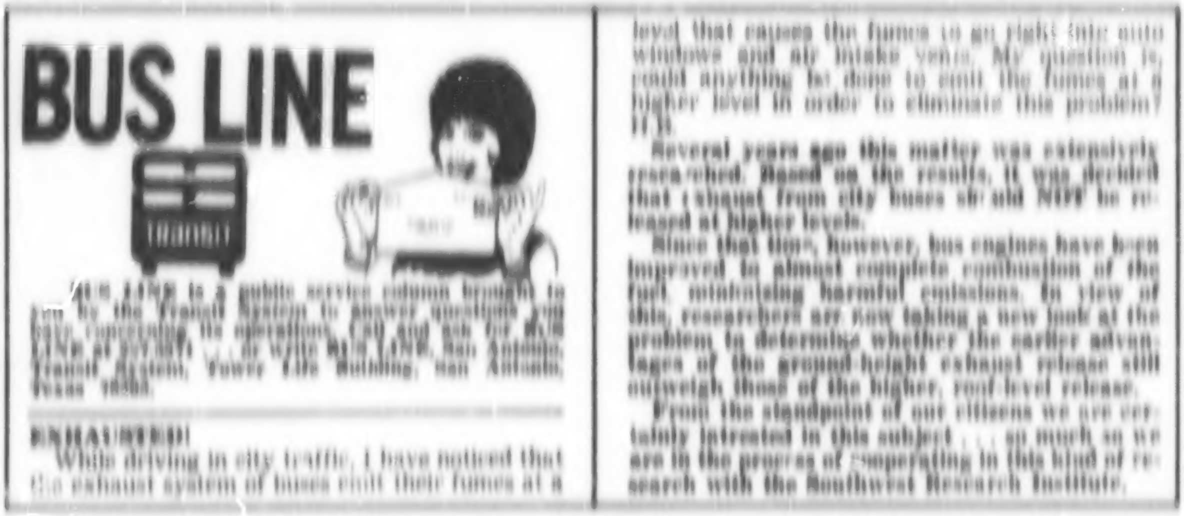
final reports worth reviewing on this subject. Two surveys, one in 1969 and one in 1970, tested over 5000 quota-sampled individuals according to the 1960 census in five cities. A special mobile odor facility, known as the Sniffmobile, was used to elicit responses to an odor very similar to diesel buses at a variety of intensities. The trained SwRI panel was used to calibrate the facility and odor levels in terms of the Turk kit.

Among a number of other findings, the public opinion odor testing resulted in a dose-response relationship illustrated in Figure 38. This is typical of the upper portion of the usual "S"-type dose-response odor curve. Applying the first interim inspection results of the EIP kit to this curve, it can be seen that an overall reduction (all buses and conditions averaged, equal weight each condition) from D-5.3 to D-3.5 results in a fairly small reduction in public objectionability. The reduction is on the order of 10 percent.

Incidentally, D-5.3 is about 0.6 to 0.7 D-numbers below the level of odor that was experienced in nearby operations of old buses powered by the 71 series Detroit Diesel engine with "N" injectors and horizontal tailpipes. This difference is attributed to the relatively new condition of the engines tested in this project. The overall D reduction from 5.3 to 3.5 compares nicely with the previously reported D reduction for LSN injectors from D-5.9 to D-4.2 for Bus 677. Please refer to Reference 5, Section III Fleet Test of LSN Injectors for details.

When it is recognized that odor generates a subjective response that increases less as odor strength is increased, then the relationship of Figure 38 may be understood. The reductions afforded by the LSN injectors make a necessary and good start toward reducing public awareness but alone cannot be expected to grossly reduce complaints. The EIP vertical stack, by dispersing and diluting the exhaust more than the horizontal exhaust pipe, will further reduce public awareness of the odor. Studies have not been made to quantify the extent the vertical stack, when combined with the remainder of the kit, will reduce odor noticeability. This is a case where effects measured separately will not necessarily be directly additive. There is little doubt that the vertical stack will reduce objectionability from that possible by the LSN injectors alone and will most likely reduce complaints about exhaust odor.

In the previous section, a discussion was given the pros and cons of stack placement and exhaust smoke. There is little doubt that reducing and maintaining smoke at or near the visibility limit will be the goal for the EIP vertical stack. This will be necessary, many feel, to keep awareness of smoke from negating the odor reduction. The following clipping indicates that people in the community do notice and are aware of the exhaust location on city buses.



BUS LINE

BUS LINE is a public service column brought to you by the Transit System to answer questions and help concerning its operations. Call and ask for BUS LINE at [illegible] . . . or write BUS LINE, San Antonio Transit System, Tower Life Building, San Antonio, Texas [illegible].

EXHAUSTED!

While driving in city traffic, I have noticed that the exhaust system of buses emit their fumes at a level that causes the fumes to go right into auto windows and air intake vents. My question is, could anything be done to emit the fumes at a higher level in order to eliminate this problem? H.B.

Several years ago this matter was extensively researched. Based on the results, it was decided that exhaust from city buses should NOT be released at higher levels.

Since that time, however, bus engines have been improved to almost complete combustion of the fuel, minimizing harmful emissions. In view of this, researchers are now taking a new look at the problem to determine whether the earlier advantages of the ground-height exhaust release still outweigh those of the higher, roof-level release.

From the standpoint of our citizens we are certainly interested in this subject . . . so much so we are in the process of cooperating in this kind of research with the Southwest Research Institute.

VII. SUMMARY

Three GM city busses have been equipped with the GM Truck and Coach Environmental Improvement Proposal retrofit kit and operated approximately 25,000 miles. Noise tests were made before and after kit installation and interior noise reductions, claimed by the manufacturer, were confirmed. Exterior noise may increase if engine-transmission upshift changes are necessary by the operator to meet the recommendations of the kit.

With regard to odor, smoke, and other tailpipe emissions, the LSN improved needle injectors were found to give consistently and substantially lower smoke, odor, hydrocarbons, carbon monoxide, and oxygenates during this initial 25,000-mile-test period. The catalytic muffler, one item included in the EIP kit, was found to be largely ineffective in reducing emissions. This lack of performance was found for all buses, conditions, and, except for one bus when new, both inspections. One small disadvantage of the otherwise splendid and highly attractive cost-effectiveness of the LSN injectors was the 10- to 15-percent increase in nitric oxide emissions. The vertical stack, also featured in the EIP kit, has the effect of making odor and noise less noticeable to the man-in-the-street, but may make smoke more visible. These findings are in agreement with component studies conducted during the past 2 years with the catalytic muffler and improved injectors.

In closing, investigation of the claims for the EIP kit is not final. To date, however, the LSN injectors continue to appear highly advisable for immediate retrofit to all buses equipped with S-type injectors. The LSN injector is standard equipment on all 1970 and 1971 GM 2-stroke diesel engines used in on-highway operation. Three more inspections, one after 40,000 miles and two during the last 18 or so months of the demonstration, are planned. These tests will determine how deterioration, etc., affects the performance of the kit and its major components.

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APPENDIX A

DESCRIPTION OF VEHICLES, EMISSIONS, AND NOISE TEST PROCEDURES

TABLE A-1. DESCRIPTION OF TEST VEHICLES AND ENGINES

Bus Number	702	704	707
Vehicle Data			
Manufacturer	Truck and Coach Div. GMC	Truck and Coach Div. GMC	Truck and Coach Div. GMC
Model	TDH-4519	TDH-4519	TDH-4519
Chassis number	032	034	358
Source	S.A. Transit	S.A. Transit	S.A. Transit
Air conditioned	Yes	Yes	Yes
Year	1963	1963	1964
Miles	368,356	357,063	284,584
Engine Data			
Manufacturer	Detroit Diesel Div. GMC	Detroit Diesel Div. GMC	Detroit Diesel Div. GMC
Engine number	6V-71E	6V-71E	6V-71E
Cycles	2	2	2
Hp rating at 2100 rpm	200	200	200
Cylinders/Arrangement	6/V	6/V	6/V
Compression ratio	17:1	17:1	17:1
Displacement, cu. in.	425.6	425.6	425.6
Bore and stroke, in.	4-1/4 × 5	4-1/4 × 5	4-1/4 × 5
Number of exhaust valves	2	2	2
Type injectors	Unit	Unit	Unit
Injector size	608	608	608
Engine Maintenance			
Total miles (start of test)	368,356	357,063	284,584
Miles since injector change	22,356	36,620	13,884
Miles since major overhaul	34,625	36,620	19,884
Drive Line Data			
Transmission	Allison V-H	Allison V-H	Allison V-H
Number of forward speeds	2	2	2
Rear axle	Rockwell Standard	Rockwell Standard	Rockwell Standard
Rear axle ratio	4.714:1	4.714:1	4.714:1
Number of drive axles	1	1	1
Tire size	11.00 × 20	11.00 × 20	11.00 × 20

ENGINE MANUFACTURERS ASSOCIATION

PROPOSED
DIESEL EMISSION APPROVAL PROCEDURE

for the

STATE OF CALIFORNIA
AIR RESOURCES BOARD

prepared by

THE GASEOUS EMISSION SUBCOMMITTEE
of the
EMISSION STANDARDS COMMITTEE

Draft #7 - (Incorporates changes and additions from 12-11-69 Joint Meeting, EMA Meetings on 2-24-70, 3-18-70 and 4-23-70 and Joint Meeting of 4-29-70)

Introduction

A. The following procedure will be used in the testing program to determine the conformity of new diesel engines, used in heavy duty vehicles, with the standards set forth in this procedure.

B. The standards for hydrocarbons, nitric oxide, and carbon monoxide are expressed in mass units of grams per brake horsepower hour and represent the mass rate of emissions per unit of work accomplished.

C. Certification of conformity with the standards is based on engine testing and certification. In addition, vehicle manufacturers must also certify that vehicle models manuvactured for sale in California use certified engines.

D. The engines to be tested for certification are selected according to families of similar design.

E. For certification the emissions are measured during an engine dynamometer test on a three-speed, thirteen-mode, steady state cycle with equal weighting factors for ten of the modes. The cycle is a composite of many typical cycles for heavy duty vehicles.

F. The emissions are continuously measured in accordance with SAE Recommended Practices using non-dispersive infrared equipment for CO and NO and a heated flame ionization analyzer for HC and are measured during steady state engine operation partly to allow the hydrocarbon emissions to stabilize. The mass rate of emissions is calculated from the emission concentration data and the exhaust flow data for each mode. The final emissions are calculated by dividing the summation of the weighted mass rate emissions by the summation of the weighted brake horsepower values for the cycle.

G. A chassis dynamometer procedure is also included for field surveillance testing. This procedure requires direct measurement of fuel flow and emissions concentration values. Engine brake horsepower and exhaust flow are determined from engine manufacturers data. The duration of each of the 13-modes has been minimized to reduce the total test time and tire durability problems. Because the horsepower and exhaust flow are estimated and because of the greater difficulty of controlling the test conditions, this procedure is inherently less accurate than the engine dynamometer procedure.

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A. General Provisions

I. Applicability

The provisions of Sections A, B and C are applicable to all new diesel-powered, heavy-duty vehicles manufactured on or after January 1, 1973, to be sold in California.

II. Definitions

a) "Heavy-duty vehicle" means a motor vehicle designed primarily for transportation of persons or property on a street or highway and rated more than 6000 pounds gross vehicle weight.

b) "Gross vehicle weight" means the manufacturers gross vehicle weight rating.

c) "Diesel engine" means a compression ignition engine used as the propulsion unit for a heavy duty vehicle.

d) "Exhaust emission" means substances emitted to the atmosphere from any opening downstream from the exhaust port of an engine.

e) "Rated brake horsepower" means the maximum brake horsepower output of an engine as stated by the manufacturer.

f) "Rated speed" means the speed at which the manufacturer specifies the rated brake horsepower of an engine.

g) "Rated torque" means the maximum torque produced by an engine as stated by the manufacturer.

h) "Peak torque speed" means the speed at which the engine develops maximum torque.

i) "Percent load" means the fraction of the maximum available torque at that engine speed.

j) "Intermediate speed" means the peak torque speed or 60% of rated speed, whichever is higher.

III. Abbreviations

The abbreviations used in this part have the following meanings in both capital and lower case:

ASTM = American Society for Testing and Materials
BHP = Brake Horsepower
BSHC = Brake Specific Hydrocarbons
BSNO = Brake Specific Nitric Oxide
BSCO = Brake Specific Carbon Monoxide
CO_2 = Carbon Dioxide
CO = Carbon Monoxide
Conc = Concentration
cfm = Cubic Feet Per Minute
EP = End Point
Exh = Exhaust
F = Fahrenheit
Ft = Feet
g = Gram (s)
GVW = Gross Vehicle Weight
HC = Hydrocarbon (s)
H_2 = Hydrogen
Hg = Mercury
HP = Horsepower

hr = Hour

IBP = Initial Boiling Point

in. = Inch(es)

Int = Intake

lb = Pound (s)

Max = Maximum

ml = Milliliters

min. = Minimum = Minute

M = Mass

N_2 = Nitrogen

NO = Nitric Oxide

O_2 = Oxygen

ppm = Parts Per Million by Volume

rpm = Revolutions Per Minute

SAE = Society of Automotive Engineers

sec = Second

WF = Weighting Factor

F.I.D. = Flame Ionization Detector

° = Degrees

% = Percent

Σ = Summation

IV. Standards

a) Exhaust emissions from diesel engines subject to this subpart shall not exceed:

1. Hydrocarbons = ___grams per brake horsepower hour.
2. Nitrogen oxides = ___grams of nitric oxide per brake horsepower hour.
3. Carbon monoxide = ___grams per brake horsepower hour.

b) The standards set forth in paragraph a) of this section refer to exhaust emissions measured under the conditions set forth in the "Engine Dynamometer Test Procedure", Section C.

B. Approval of Engines and Vehicles

I. Application for Approval

a) An application for a Resolution of Approval to these regulations may be made to the Air Resources Board by any engine or vehicle manufacturer.

b) The application shall be in writing, signed by an authorized representative of the manufacturer, and shall contain the information required by the following sections.

II. Vehicle Approval

a) The vehicle manufacturer shall provide the following in his application:

1) Identification and description of the vehicle models with respect to which approval is requested.

2) Identification and description of the engines to be used in these vehicle models.

3) The engine manufacturers' Resolutions of Approval or pending application for these engines shall be referenced.

III. Engine Manufacturer Approval

a) The engine manufacturer shall provide the following in his application:

1) Identification and description of the engines and engine families with respect to which approval is requested as follows:

i) Engine Family Selection

The engines for which approval is requested shall be divided into engine families on the basis of design features. Engine models may be placed in one engine family when they use the same combustion cycle (2-cycle or 4-cycle), combustion system (open chamber, pre-chamber, or M-system, etc.) and method of air aspiration (natural, turbocharged, supercharged). An engine family may consist of models with different numbers of cylinders and cylinder configuration (in-line or Vee) and may have different bore or stroke dimensions if the models in a given cylinder configuration use the same basic cylinder block.

ii) Emission Engine Selection

One engine of each family shall be tested to determine the emissions characteristics of the family. The engine selected shall be the model with the highest projected sales volume for the United States. If the projected United States sales volume for an engine family for the calendar year for which certification is requested is less than ___ engines, no emissions test shall be required for that engine family.

2) A description of emission control systems or devices including such engine components and adjustments which are critical to the control of emissions.

3) Emission data on such engines tested in accordance with the applicable emission test procedures and evidence demonstrating the durability of the system.

4) A statement that the engines with respect to which data are submitted have been tested in accordance with the applicable test procedures, that they meet the requirements of such tests and that, on the basis of such tests, they conform to the requirements of the regulations.

5) A statement of recommended maintenance procedures and equipment necessary to assure that the vehicle and engine in operation conform to the regulations and a description of the program for training of personnel for such maintenance.

6) An agreement to make one or more of the test engines and instrumentation available for emissions testing at the manufacturer's facility upon request of the Executive Officer when such request is made not later than one month after submission of the Application for Approval. Any such testing requested by the Executive Officer will be scheduled as promptly as possible subject to the availability of personnel and facilities to conduct such tests.

C. Engine Dynamometer Test Procedure

I. Introduction

a) The following procedure shall be used in the testing program to determine the conformity of diesel engines with the applicable standards set forth in Part A.

b) The test procedure consists of a prescribed sequence of engine operating conditions on an engine dynamometer with measurement of hydrocarbons, nitric oxide, and carbon monoxide during thirteen steady-state modes with five modes at rated engine speed, five modes at an intermediate engine speed, and three modes at idle speed.

II. Fuel Specification

a) The diesel fuels employed shall be clean and bright, with pour and cloud point adequate for operability. The fuels may contain non-metallic additives as follows: cetane improver, metal deactivator, anti-oxidant, dehazer, anti-rust, pour depressant, dye, and dispersant.

b) Fuel meeting the following specifications shall be used in exhaust emission testing:

Item	ASTM No.	Range
Cetane	D-613	42-50
Distillation range	D-86	
IBP °F		340-400
10% point °F		400-460
50% point °F		470-540
90% point °F		550-610
EP °F		580-660
Gravity ° API	D-287	33-37
Total sulfur % max.	D-129	0.2-0.5
Flash point °F-Min.	D-93	130
Viscosity, centistokes	D-445	2.0-3.2

III. Instrumentation

a) Instrumentation shall be provided to measure the following engine operating data:

1) Engine speed: rpm
2) Torque: lb-ft
3) Mass fuel consumption: lb/min
4) Observed barometer: in. Hg
5) Water vapor pressure: in. Hg
6) Intake air restriction: in. water
7) Exhaust back pressure: in. Hg
8) Intake air temperature: °F
9) Fuel temperature at pump inlet: °F

b) Instrumentation shall be provided to measure the engine intake air flow or exhaust flow and the concentration of carbon monoxide, nitric oxide, and hydrocarbons in the exhaust as follows:

1) The determination of the carbon monoxide and nitric oxide concentrations shall be accomplished using sampling and analysis by non-dispersive infrared methods using the SAE Recommended Practice # ___ titled "Measurement of Carbon Dioxide, Carbon Monoxide, and Oxides of Nitrogen in Diesel Exhaust",

2) The determination of the hydrocarbon concentration shall be accomplished using sampling and analysis by a heated flame ionization detector method using the SAE Recommended Practice #__ titled "Continuous Hydrocarbon Analysis of Diesel Exhaust".

3) The determination of the intake air flow or exhaust flow shall be accomplished using the SAE Recommended Practice #__ titled "The Measurement of Intake or Exhaust Flow in Diesel Engines".

IV. Test Conditions

a) The following ranges of test conditions shall be maintained during exhaust emission testing:

1) Intake air temperature: 85°F ± 15°F

2) Barometric pressure: 29.4 in. Hg ± 1 in. Hg

3) Fuel temperature at fuel pump inlet: 100°F ± 10°F

4) Intake restriction: between the manufacturer's published maximum limits of clean air cleaner restriction and dirty air cleaner restriction.

5) Exhaust restriction: Maximum permitted by the engine manufacturer as published in his sales and service literature. The restriction shall be set within ± 0.2 in. Hg while the engine is operating at maximum horsepower.

V. Test Procedure for Exhaust Emissions

a) The engine shall be run-in according to the manufacturer's recommendation for break-in of an engine for engineering performance testing.

2 OF 2

PB

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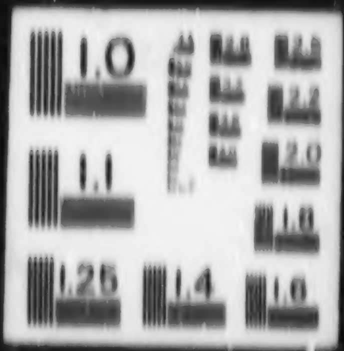

1.0
1.1
2.0
1.8
1.25
1.4
1.6

b) Pre-test Conditioning Procedure

1) Operate the engine at 90% ± 10% load at 90% ± 10% of rated speed for a 50-hour conditioning period.

2) The engine may be shut down at the end of or during the 50-hour conditioning period.

c) Emissions Measurement Procedure

1) Start the engine and warm it up. Complete warm-up at rated speed and full load for at least ten minutes or until all temperatures and pressures have reached equilibrium.

2) Operate the engine at the following modes:

Engine Speed	Percent Load ± 2%
Low idle	0%
Intermediate	2%
Intermediate	25%
Intermediate	50%
Intermediate	75%
Intermediate	100%
Low idle	0%
Rated	100%
Rated	75%
Rated	50%
Rated	25%
Rated	2%
Low idle	0%

3) Operate the engine for ten minutes in each mode, allowing up to one minute for engine speed or load changes, at least eight minutes for emission stabilization, and one minute for emission measurement.

i) Record the following for the full ten minutes in each mode on a strip chart recorder:

a) hydrocarbon analyser output
b) carbon monoxide analyser output
c) nitric oxide analyser output

ii) Record the following data during the last five minutes in each mode:

a) engine speed
b) engine torque or dynamometer load units
c) intake air temperature
d) exhaust back pressure
e) intake restriction
f) fuel temperature

iii) Record data during the last five minutes in each mode in order to calculate the following:

a) intake air flow or exhaust flow
b) fuel flow

4) Shut the engine down for at least eight hours. Then, repeat the emissions measurement procedure, Section C,V,(c).

d) Chart Reading

1) Locate the last sixty seconds of each mode and determine the average chart reading for hydrocarbons, carbon monoxide, and nitric oxide over this one minute period.

2) Determine the concentration HC, CO, and NO (HC_{conc}, CO_{conc}, NO_{conc}) in each mode from the chart reading (Item C,V,(d)(1)) and from the calibration data. Average the values obtained during the three idle modes.

e) Calculations

1) The test results for the two emission test sequences shall be derived through the following steps:

i) Calculate the mass emissions for HC, CO, and NO in grams per hour for each mode as follows:

a) $HC_{mass} = 0.0132 \times HC_{conc}$ (ppm - carbon) x exh mass (lb/min)

b) $CO_{mass} = 0.0263 \times CO_{conc}$ (ppm) x exh mass (lb/min)

c) $NO_{mass} = 0.0282 \times NO_{conc}$ (ppm) x exh mass (lb/min)

ii) Calculate the weighted BHP, HC_{mass}, CO_{mass}, and NO_{mass} for each mode by multiplying the values of each by the weighting factor for that mode. The weighting factors are 0.20 for the average idle mode and 0.08 for all other modes.

iii) Calculate the brake specific emissions for HC, CO, and NO for each set of data as follows:

$$BSHC = \frac{\Sigma (HC_{mass} \times WF)}{\Sigma (BHP \times WF)}$$

$$BSCO = \frac{\Sigma (CO_{mass} \times WF)}{\Sigma (BHP \times WF)}$$

$$BSNO = \frac{\Sigma (NO_{mass} \times WF)}{\Sigma (BHP \times WF)}$$

iv) Average the brake specific emissions from the two test sequences to compare to the standards.

D. Field Surveillance Chassis Dynamometer Test Procedure

I. Introduction

a) The following procedure may be used in the field surveillance testing of diesel-powered, heavy-duty vehicles.

b) The test procedure consists of a prescribed sequence of engine operating conditions using a vehicle chassis dynamometer with measurement of hydrocarbons, nitric oxide, and carbon monoxide during the same thirteen modes as used in the engine dynamometer procedure except the operating time in each mode is shortened to minimize tire failure problems.

c) This test procedure is similar to the engine dynamometer procedure except that the engine exhaust flow and brake horsepower are obtained from the engine manufacturers' data and fuel rate measurements during the test. Because of this and the greater difficulty in controlling test conditions, this procedure is inherently less accurate than the engine dynamometer procedure.

II. Fuel Specification

a) The fuel used for this procedure shall meet the same specifications required for the engine dynamometer procedure (Section C, II).

III. Instrumentation

a) Instrumentation shall be provided to measure the following:

1) Engine speed: rpm
2) Observed barometer: in. Hg
3) Water vapor pressure: in. Hg
4) Intake air restriction: in. water
5) Exhaust back pressure: in. Hg
6) Intake air temperature: °F
7) Fuel temperature at pump inlet: °F

b) Instrumentation shall be provided to measure the concentration of carbon monoxide, nitric oxide, and hydrocarbons in the exhaust as follows:

1) The determination of the carbon monoxide and nitric oxide concentrations shall be accomplished using sampling and analysis by nondispersive infrared methods using the SAE Recommended Practice #__ titled "Measurement of Carbon Dioxide, Carbon Monoxide, and Oxides of Nitrogen in Diesel Exhaust" except the time in mode shall be as prescribed in Section D,V(c).

2) The determination of the hydrocarbon concentration shall be accomplished using sampling and analysis by a heated flame ionization detector method using the SAE Recommended Practice #__ titled "Continuous Hydrocarbon Analysis of Diesel Exhaust" except the time in mode shall be as prescribed in Section D, V(c)(4).

c) Equipment shall be provided to measure the mass fuel consumption rate and to control the temperature of the fuel supplied to the engine. The fuel rate instrumentation must provide a continuous indication of fuel rate (weigh tank systems are not satisfactory). A system incorporating calibrated rotometers (fuel viscosity and temperature affect calibration) or a mass flow meter, a heat exchanger, and float tank similar to that shown in Figure 1 is satisfactory.

IV. Test Conditions

a) The following ranges of test conditions should be maintained as closely as possible during exhaust emission testing: deviations from these conditions will cause increasing errors in brake specific emissions values.

1) Intake air temperature: 85° ± 15° F
2) Barometric pressure: 29.4 in. Hg ± 1 in. Hg
3) Fuel temperature: 100° F ± 10° F
4) Intake restriction: between the manufacturers' published maximum limits of clean air cleaner restriction and dirty air cleaner restriction.
5) Exhaust restriction: typical encountered in the vehicle but no higher than manufacturers' published limit.

V. Test Procedure for Exhaust Emissions

a) Pre-Test Conditioning

Operate the vehicle on the chassis dynamometer with the engine at 85 ± 10% of rated speed and 50 ± 10% of maximum rear wheel horsepower at that speed for at least 15 minutes or until the transmission and rear axle temperatures have stabilized.

b) Selection of Test Conditions

1) Measure the maximum fuel rate for the test engine at the rated and intermediate engine speeds.

2) Obtain curves of engine brake horsepower and exhaust flow as functions of fuel rate for the engine model being tested from the engine manufacturer (Figures 2 and 3).

3) Use the brake horsepower vs. fuel rate data (Fig. 2) to estimate the maximum brake horsepower produced by the test engine at the rated and intermediate speeds. These are the 100% load conditions to be used during the test.

4) Calculate the engine brake horsepower at 75, 50, and 25% load for rated and intermediate speeds using the estimated maximum brake horsepower values from D,V(b)(3) above.

5) Determine the fuel rates associated with the engine brake horsepower values calculated in D,V(b)(4) above from Fig. 2.

c) Emissions Test Procedure

1) Warm up engine, transmission and rear axle by operating at rated engine speed and 30-50 mph for at least 15 minutes or until engine oil and transmission temperatures have stabilized.

2) Record the barometer and vapor pressure at the beginning of the test.

3) Operate the engine at the following modes using fuel rate values within ±5% of the values calculated in Section D,V,(b).

Engine Speed	Percent Load
Low Idle	Declutched
Intermediate	Declutched
Intermediate	25%
Intermediate	50%
Intermediate	75%
Intermediate	100%
Low Idle	Declutched
Rated	100%
Rated	75%
Rated	50%
Rated	25%
Rated	Declutched
Low Idle	Declutched

4) Operate the engine for three minutes in each mode allowing up to one minute for engine speed or load changes, at least one minute for emission stabilization, and one minute for emission measurement. Record the following data during the final two minutes in each mode:

a) Hydrocarbon analyzer output
b) Carbon monoxide analyzer output
c) Nitric oxide analyzer output
d) Engine speed
e) Fuel flow rate
f) Fuel temperature at pump inlet
g) Intake air temperature
h) Intake air restriction
i) Exhaust restriction

d) Chart Reading

1) Locate the last sixty seconds of each mode and determine the average chart reading for hydrocarbons, carbon monoxide, and nitric oxide over this one minute period.

2) Determine the concentration of HC, CO, and NO (HC_{conc}, CO_{conc}, NO_{conc}) in each mode from the chart reading D,V(d)(1) and from the calibration data. Average the three idle modes.

3) Determine the engine brake horsepower and mass exhaust flow from the manufacturer's data using the fuel rate measured during each mode from Figures 2 and 3.

f) Calculations

1) The test results for the emissions test sequences shall be derived through the following steps:

i) Calculate the mass emissions for HC, CO, and NO in grams per hour for each mode as follows:

$HC_{mass} = 0.0132 \times HC_{conc}$ (ppm-carbon) × exh mass (lb/min)

$CO_{mass} = 0.0263 \times CO_{conc}$ (ppm) × exh mass (lb/min)

$NO_{mass} = 0.0282 \times NO_{conc}$ (ppm) × exh mass (lb/min)

ii) Calculate the weighted BHP, HC_{mass}, CO_{mass}, and NO_{mass} for each mode by multiplying the value of each by the weighting factor for that mode. The weighting factors are 0.20 for the average idle mode and 0.08 for all other modes.

iii) Calculate the brake specific emissions for HC, CO, and NO as follows:

$$BSHC = \frac{\Sigma(HC_{mass} \times WF)}{\Sigma(BHP \times WF)}$$

$$BSCO = \frac{\Sigma(CO_{mass} \times WF)}{\Sigma(BHP \times WF)}$$

$$BSNO = \frac{\Sigma(NO_{mass} \times WF)}{\Sigma(BHP \times WF)}$$

FIGURE 1

FUEL FLOW MEASUREMENT SYSTEM

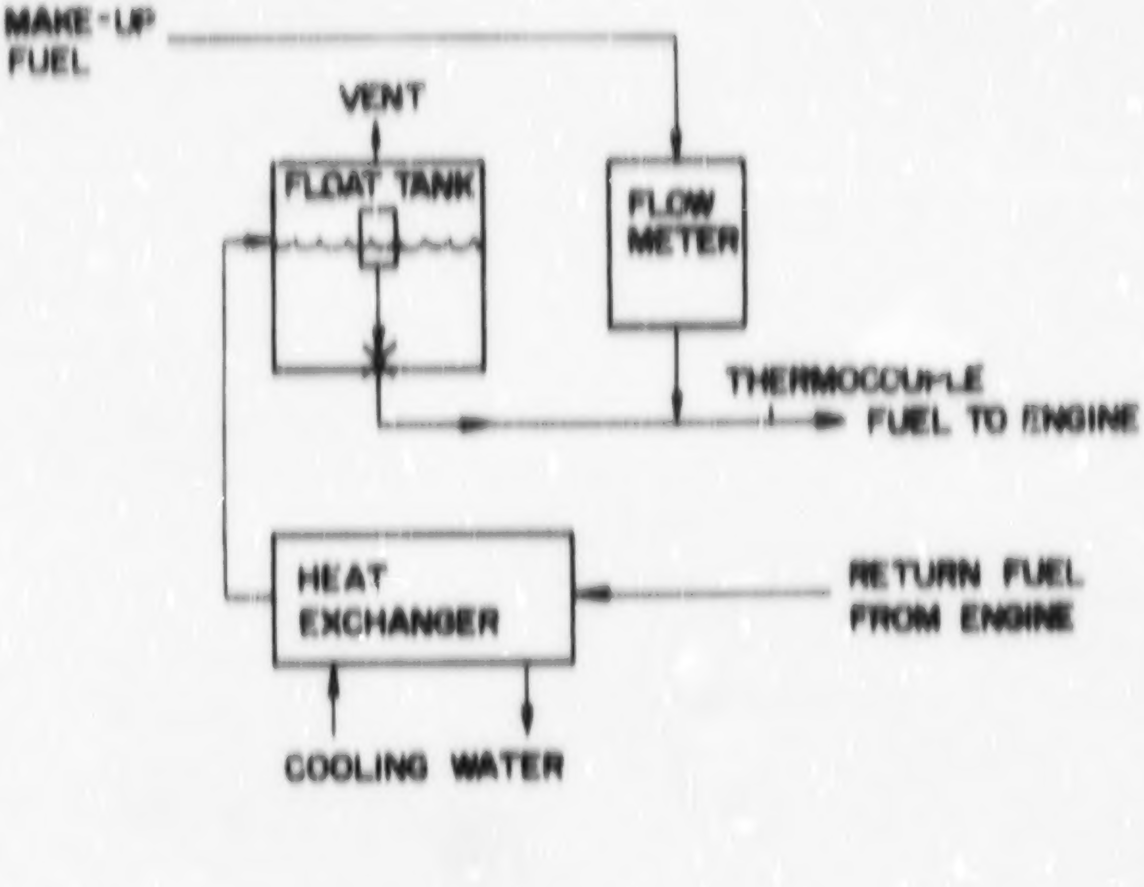

MAKE-UP FUEL
VENT
FLOAT TANK
FLOW METER
THERMOCOUPLE
FUEL TO ENGINE
HEAT EXCHANGER
RETURN FUEL FROM ENGINE
COOLING WATER

Figure 2

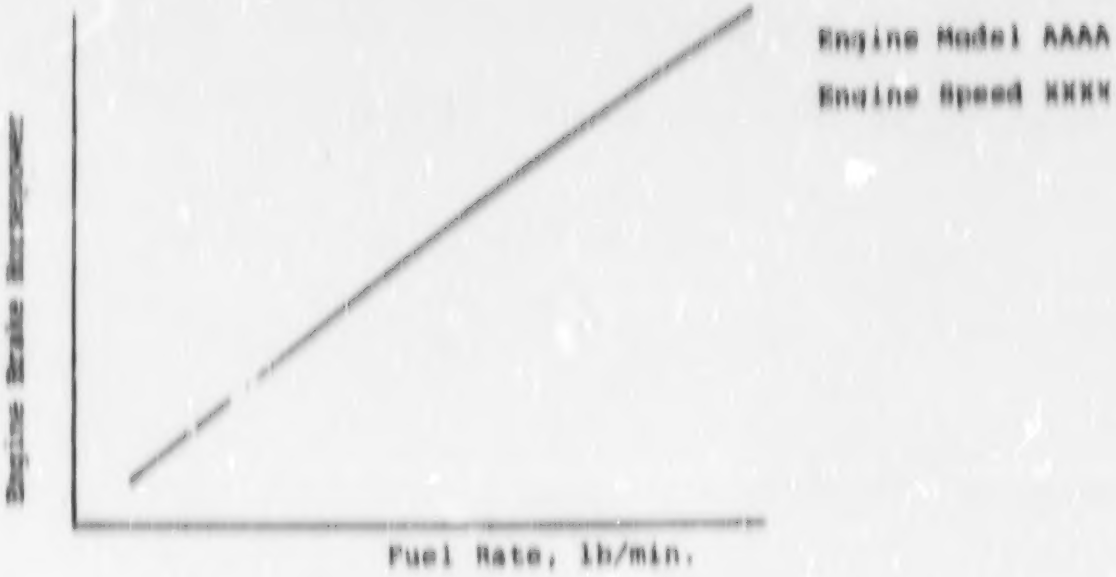
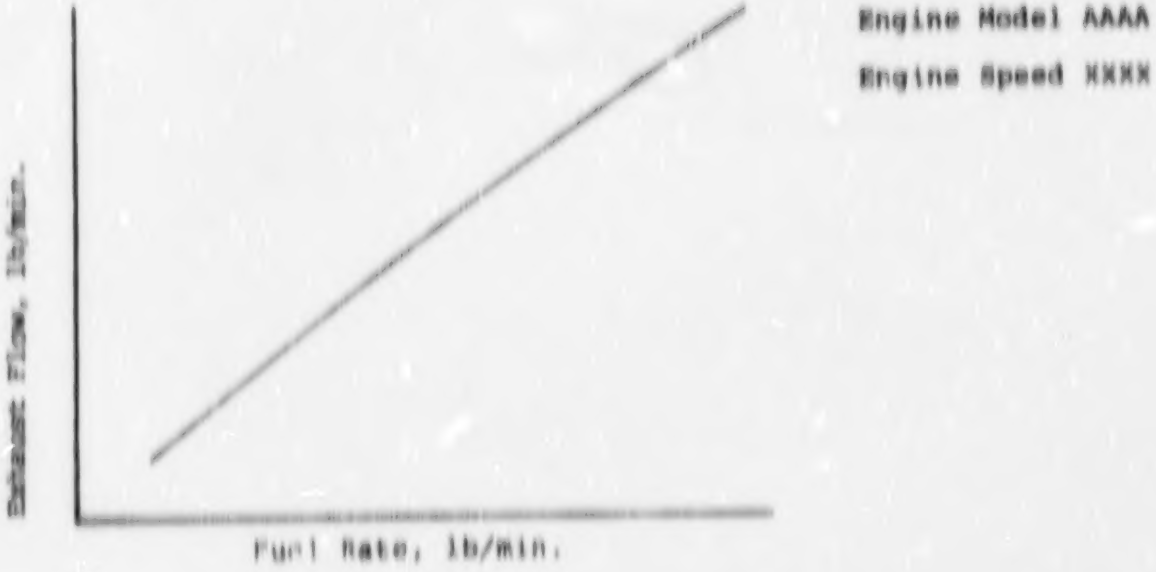


Figure 3



GMC SERVICE

Coach Service Information Bulletin

GMC TRUCK & COACH DIVISION · GENERAL MOTORS CORPORATION

IMPORTANT—All Service Personnel Should Read and Initial

NUMBER: C-80-1-1
GROUP: 12-FUEL-7

DATE: January 18, 1980

Subject: CATALYTIC MUFFLER
Models: TRANSIT AND SUBURBAN COACHES EQUIPPED WITH SUBJECT MUFFLER
Effective: SERVICE ONLY

The purpose of this Bulletin is to inform coach operators of the recommended maintenance program for the horizontal bed catalytic muffler.

INFORMATION

Some coaches are equipped with horizontal bed catalyst mufflers on special orders. These mufflers are available in two types, for use with 6V-71 or 8V-71 engines. The 6V type requires 38.5 pounds of catalyst pellets and the 8V requires 50 pounds. Pellets can be obtained through regular parts channels in 38.5 pound quantities.

INSTRUCTIONS

1. Exhaust back pressure is directly related to carbon build-up on the pellets and should be periodically checked at a point two inches upstream from the pipe flange in the manifold. Maximum allowable pressure is nine to ten inches of mercury at 2100 engine rpm. If the back pressure reaches the maximum, the catalyst pellets should be changed. The injector timing, air inlet restriction, fuel, compression pressure, condition of injectors, and engine tune-up in general should be checked if engine is smoking excessively.
2. Check the catalyst level every six (6) months or 20,000 miles, whichever occurs first. This can be done by removing the plug in the side of the muffler. If the level falls below the midline of the hole, additional catalyst pellets should be added to bring the level back to the midline.
3. Durability testing of the catalyst indicates that the level of the catalyst muffler effectiveness is continued at 40,000 miles but that there is sufficient deterioration in the catalyst activity to discontinue its use beyond this point as its effect is marginal. Catalyst contamination by carbon build-up on areas of the pellets will accelerate the deterioration and thus good engine maintenance is necessary to prolong the catalyst life. To change the pellets, it is necessary to remove the muffler from the coach. After removing the old pellets, a full charge (one 38.5 pound package for the 6V-71 application) can be poured into the muffler, and it can be reinstalled in the coach.

PARTS INFORMATION

Part No.	Description	Quantity
6884051	Catalyst	1 Pkg. (38.5 lbs.)

Pontiac, Michigan
WP-12-807

Printed in U.S.A.

MEASUREMENT OF TRUCK AND BUS NOISE—SAE J672

SAE Standard

Report of Truck and Bus Technical Committee approved January 1957. [illegible]

Introduction—This Standard sets forth the Equipment and Procedure to be used in measuring the loudness of truck noise and loudness limits [illegible] the noise [illegible] spread up for a single loudness rating for the truck.

Equipment

1. A magnetic tape recorder of broadcast transcription or instrument quality.

2. A high quality microphone, possessing ruggedness and stability [illegible] at the test site.

3. A [illegible] of at least a single frequency overall acoustical calibration at the test site.

4. A set of octave bandpass filters meeting ASA requirements as set forth in Bulletin [illegible]

5. A decibel indicating meter which meets the requirements for an ASA Sound Level Meter [illegible]

Procedure

Environment—Ambient noise levels in each octave band [illegible] whether this condition is being met [illegible] the truck noise.

[illegible]

Preliminary—[illegible]

Test Procedure—Place microphone 4 ft above ground, 50 ft to the

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each side from center of the lane in which the vehicle is traveling. If this distance cannot be obtained, then for working distances D, [illegible] and 50 ft correct the playback octave band levels in accordance with the relationship

$$\text{(db) Correction} = 20 \log \left(\frac{D}{50}\right)$$

As the truck passes by under the maximum noise conditions previously determined, the noise is recorded on the tape recorder [illegible] maximum [illegible] recorded. [illegible] microphone. [illegible] typical operation with maximum noise [illegible].

Record a calibration tone of known acoustic level on the tape using the same microphone and the same recorder attenuator settings [illegible].

Laboratory Procedure: Connect the tape recorder in playback [illegible] an octave filter [illegible] sound level meter [illegible] the octave band levels [illegible] calibration [illegible] playback amplifier is adjusted until the reading [illegible] "overall" setting of the filter equals the known [illegible] the truck noise recording is played back through each of the 8 filter settings [illegible] meter [illegible] are tabulated [illegible].

The octave band levels for each octave band are then converted to sones in accordance with Table 2. [illegible] individual values of sones [illegible] single reading for total loudness of the truck [illegible] on the Acoustical Grid, Fig. 1, as shown for the sample data of Table 1.

TABLE 1—SAMPLE DATA

Octave Band	Sound Pressure Level	Sones
[illegible]	[illegible]	[illegible]
		Total [illegible]

Calibration and Instrument Practice—The use of single "only" calibration tone at the time of the truck recording gives reasonable accuracy of significant data provided the overall record-playback frequency response of the entire system is [illegible], and corrections to a flat response are applied, where required, to the octave band data.

In general, good instrument practice are to be followed. For example, if a portable power supply is to be used at the test site to operate the tape recorder, its frequency must be closely controlled to [illegible]. Special shielding of microphone lines to reduce hum and random electrical disturbances shall be employed. The importance of the microphone [illegible] should be [illegible] in the recorder [illegible] should be [illegible] to [illegible] attention to [illegible] here is to be [illegible]. These [illegible] a single [illegible] used.

Proper account must be taken of any differences in filter insertion losses between the "overall" setting (which the proper amplifier gain is established for playback) and the octave bandpass settings. In some filters these two insertion losses are not equivalent.

Sources of Error—Even assuming an idealized flat overall response and stability of all components of the record-playback system, there are factors external to the instrument system which cause variations in the loudness measured by any procedure, including the above procedure. These include:

1. Variations due to differences in operation (such as engine speed and load) in successive runs on the same truck, where variations in truck condition and atmospheric conditions are thus minimized.
2. Variations in sound output of the truck itself from day to day.

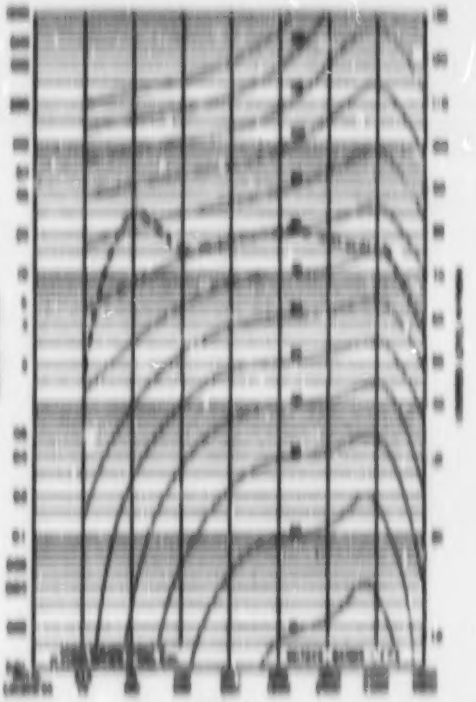

FIG. 1

3. Variations in the atmospheric "transmission system" between the truck and the microphone due to:
   (a) Temperature gradients
   (b) Wind velocity gradients
4. Variations between supposedly identical trucks.

Very little can be done to reduce 3 and 4, although the existence of these variations must be recognized if the truck type is to [illegible] meet the specifications. Under 3, temperature gradients of [illegible] degree can usually be avoided by conducting the testing in the [illegible] daylight hours. Wind velocity gradients can be avoided by testing when wind velocities do not exceed perhaps 10 to 15 mph.

Under 1, very little trouble will be experienced with [illegible] if care is taken on successive runs to duplicate engine speed and load.

Loudness Limit—New highway vehicles shall not exceed [illegible] 125 sones measured at 50 ft.

REFERENCES

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Calculation and Measurement of the Loudness of Sounds, [illegible] Journal of the Acoustical Society of America, Vol. 24, [illegible] (May 1952).

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Laboratory Evaluation of Field Measurements of the Loudness of Truck Exhaust Noise, [illegible], Journal of the Acoustical Society of America, Vol. 26, [illegible] (March 1954).

Related Reading: A.M.A. Method for the Evaluation of Truck Exhaust Noise, 1954 [illegible] available from the Automobile Manufacturers Association, 320 New Center Bldg., Detroit, Mich.

(Table 2 appears on next page)

MEASUREMENT OF TRUCK AND BUS [illegible]

APPENDIX B

ODOR PANEL DATA

TABLE B-1. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 702
Date: September 28, 1970

Test Configuration: LSN Injectors, Catalytic Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
4	24 mph	3.9	1.2	1.0	1.0	0.8
7	900 rpm	3.3	1.0	1.0	0.9	0.6
10	1/2 load*	3.3	1.0	0.9	0.9	0.6
15		2.8	0.9	0.8	0.7	0.3
	Average	3.3	1.0	0.9	0.9	0.5
3	32 mph	3.4	1.1	0.9	0.9	0.4
5	1200 rpm	3.2	0.9	0.9	0.7	0.8
11	1/2 load*	2.4	1.0	0.8	0.4	0.3
14		3.4	1.1	1.0	1.0	0.4
	Average	3.1	1.0	0.9	0.8	0.5
2	40 mph	4.0	1.1	1.0	0.9	1.0
8	1500 rpm	4.4	1.4	1.0	0.8	1.1
12	1/2 load*	4.1	1.3	1.0	0.9	0.9
16		3.7	1.2	1.0	0.8	0.8
	Average	4.1	1.3	1.0	0.9	1.0
1	Idle	4.1	1.2	1.0	1.0	0.8
6	Idle	4.9	1.7	1.0	0.9	1.0
9	Idle	4.6	1.4	1.0	1.0	0.9
13	Idle	4.9	1.6	1.1	1.0	1.1
	Average	4.6	1.5	1.0	1.0	1.0
17	Idle-Acceleration	4.6	1.3	1.0	1.0	1.0
20	Idle-Acceleration	4.1	1.4	1.0	0.9	0.9
23	Idle-Acceleration	4.0	1.1	1.0	1.0	1.0
24	Idle-Acceleration	3.3	1.0	1.0	0.8	0.7
	Average	4.0	1.2	1.0	0.9	0.9
18	Deceleration	4.8	1.7	1.0	1.0	1.0
19	Deceleration	4.3	1.2	1.0	1.1	1.0
21	Deceleration	4.6	1.6	1.0	0.9	1.0
22	Deceleration	4.6	1.6	1.0	1.0	1.0
	Average	4.6	1.5	1.0	1.0	1.0

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-2. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 702
Date: September 29, 1970

Test Configuration: LSN Injectors, Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
2	24 mph	2.1	1.0	0.7	0.4	0.0
7	900 rpm	3.2	1.0	0.9	0.8	0.6
9	1/2 load*	2.5	0.7	1.0	0.7	0.2
14		1.7	0.6	0.6	0.5	0.0
	Average	2.4	0.8	0.8	0.6	0.2
3	32 mph	2.9	1.0	0.9	0.7	0.2
8	1200 rpm	1.9	0.8	0.6	0.5	0.0
10	1/2 load*	1.9	0.7	0.8	0.3	0.0
13		1.9	0.9	0.7	0.3	0.0
	Average	2.2	0.9	0.8	0.5	0.1
4	40 mph	2.9	1.0	1.0	0.7	0.2
5	1500 rpm	3.1	0.9	1.0	1.0	0.2
12	1/2 load*	2.7	1.0	0.9	0.5	0.3
15		2.3	0.8	0.5	0.8	0.2
	Average	2.8	0.9	0.9	0.8	0.2
1	Idle	4.4	1.2	1.0	1.0	1.0
6	Idle	4.8	1.6	1.0	1.0	1.0
11	Idle	4.6	1.5	1.0	1.0	1.0
16	Idle	4.4	1.3	1.0	1.0	1.0
	Average	4.6	1.4	1.0	1.0	1.0
19	Idle-Acceleration	4.7	1.7	1.0	1.1	0.9
20	Idle-Acceleration	3.8	1.1	0.9	1.0	0.7
21	Idle-Acceleration	4.2	1.3	1.0	1.0	0.9
23	Idle-Acceleration	5.0	1.8	1.1	1.0	1.0
	Average	4.4	1.5	1.0	1.0	0.9
17	Deceleration	5.3	1.8	1.1	1.0	1.1
18	Deceleration	5.1	2.0	1.0	1.1	1.0
22	Deceleration	5.6	2.0	1.3	1.2	1.0
24	Deceleration	5.2	2.0	1.0	1.1	1.0
	Average	5.3	2.0	1.1	1.1	1.0

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-3. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 702
Date: October 1, 1970

Test Configuration: 608 Injectors,
Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
3	24 mph	2.3	1.0	0.2	1.0	0.1
7	900 rpm	3.0	1.0	0.7	1.0	0.2
9	1/2 load*	3.1	1.0	0.8	0.8	0.4
13		2.4	0.9	0.8	0.7	0.1
	Average	2.8	1.0	0.6	0.9	0.2
4	32 mph	3.8	1.0	1.0	1.0	0.7
5	1200 rpm	4.1	1.0	1.0	0.9	1.0
12	1/2 load*	3.4	1.0	1.0	0.9	0.6
14		2.1	0.9	0.7	0.6	0.1
	Average	3.4	1.0	0.9	0.9	0.6
2	40 mph	2.9	1.0	0.8	0.9	0.3
8	1500 rpm	3.8	1.1	1.0	1.0	0.7
10	1/2 load*	2.9	1.0	0.8	0.8	0.3
15		3.1	1.0	0.8	1.0	0.3
	Average	3.2	1.0	0.9	0.9	0.4
1	Idle	5.0	1.7	1.0	1.0	1.0
6	Idle	5.4	2.1	1.0	1.4	1.0
11	Idle	5.0	1.8	1.0	1.1	1.0
16	Idle	5.0	1.7	1.1	1.1	1.0
	Average	5.1	1.8	1.0	1.2	1.0
17	Idle-Acceleration	5.0	1.7	1.0	1.1	1.0
20	Idle-Acceleration	6.0	2.0	1.3	1.1	1.3
22	Idle-Acceleration	5.9	1.9	1.6	1.0	1.3
24	Idle-Acceleration	5.6	1.9	1.1	1.1	1.2
	Average	5.6	1.9	1.3	1.1	1.2
18	Deceleration	5.9	2.0	1.1	1.6	1.2
19	Deceleration	5.9	1.8	1.3	1.4	1.1
21	Deceleration	5.7	2.0	1.4	1.1	1.1
23	Deceleration	5.3	1.9	1.0	1.2	1.1
	Average	5.7	1.9	1.2	1.3	1.1

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-4. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 704
Date: September 14, 1970

Test Configuration: LSN Injectors, Catalytic Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
3	24 mph	2.5	1.0	0.6	0.8	0.0
7	900 rpm	2.8	1.0	0.9	0.8	0.3
9	1/2 load*	3.5	1.0	1.2	1.0	0.4
13		2.9	1.0	0.9	0.9	0.1
	Average	2.9	1.0	0.9	0.9	0.2
4	32 mph	2.8	1.0	0.9	0.9	0.0
5	1200 rpm	2.8	1.0	1.0	0.8	0.1
10	1/2 load*	2.3	0.6	0.8	0.9	0.3
14		1.5	0.4	0.9	0.4	0.1
	Average	2.4	0.8	0.9	0.8	0.1
2	40 mph	1.5	0.6	0.5	0.3	0.0
8	1500 rpm	4.0	1.2	1.0	0.9	0.6
12	1/2 load*	2.9	0.9	0.9	0.8	0.3
15		3.0	0.9	1.0	0.5	0.8
	Average	2.9	0.9	0.9	0.6	0.4
1	Idle	1.8	0.9	0.5	0.4	0.0
6	Idle	4.1	1.4	1.0	0.8	0.8
11	Idle	4.4	1.2	0.9	1.2	1.0
16	Idle	4.4	1.4	0.9	1.0	0.9
	Average	3.7	1.2	0.8	0.9	0.7
17	Idle-Acceleration	4.0	1.5	1.0	0.9	0.5
19	Idle-Acceleration	3.8	1.2	1.0	0.6	0.8
22	Idle-Acceleration	3.3	1.2	1.0	0.8	0.5
23	Idle-Acceleration	4.0	1.2	1.0	0.8	1.0
	Average	3.8	1.3	1.0	0.8	0.7
18	Deceleration	4.0	1.4	1.0	1.0	0.8
20	Deceleration	3.6	1.3	1.0	0.8	0.6
21	Deceleration	3.3	1.0	1.0	0.9	0.5
24	Deceleration	3.4	1.0	1.0	0.9	0.5
	Average	3.6	1.2	1.0	0.9	0.6

---

*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-5. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 704
Date: September 17, 1970

Test Configuration: L5N Injectors,
Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
3	24 mph	2.2	0.8	0.4	0.9	0.2
5	900 rpm	2.9	1.0	0.7	1.0	0.2
11	1/2 load*	2.0	1.0	0.7	0.3	0.1
16		2.4	0.9	0.9	0.6	0.2
	Average	2.4	0.9	0.7	0.7	0.2
1	32 mph	2.4	0.8	0.7	0.7	0.0
6	1200 rpm	2.3	0.9	0.9	0.6	0.2
12	1/2 load*	2.1	0.8	0.6	0.7	0.1
13		1.9	0.8	0.7	0.4	0.1
	Average	2.2	0.8	0.7	0.6	0.1
4	40 mph	3.4	1.1	0.9	0.9	0.2
7	1500 rpm	3.1	0.9	0.9	1.0	0.3
9	1/2 load*	3.2	1.0	0.9	0.9	0.4
14		2.7	0.9	1.0	0.7	0.2
	Average	3.1	1.0	0.9	0.9	0.3
2	Idle	4.1	1.0	1.0	1.0	1.0
8	Idle	4.1	1.1	1.0	1.0	0.8
10	Idle	3.9	1.0	1.0	1.0	0.7
15	Idle	3.7	1.1	0.8	1.0	0.7
	Average	4.0	1.1	1.0	1.0	0.8
18	Idle-Acceleration	4.6	1.4	1.1	0.9	0.9
20	Idle-Acceleration	4.3	1.3	1.1	0.9	1.0
21	Idle-Acceleration	5.0	1.4	1.2	1.0	1.0
24	Idle-Acceleration	4.6	1.3	1.0	1.0	1.0
	Average	4.6	1.4	1.1	1.0	1.0
17	Deceleration	1.9	1.0	0.7	0.1	0.2
19	Deceleration	2.9	1.0	0.9	0.4	0.6
22	Deceleration	2.9	1.0	1.0	0.7	0.6
23	Deceleration	2.7	1.1	0.8	0.8	0.1
	Average	2.6	1.0	0.9	0.5	0.4

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-6. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 704
Date: September 17, 1970

Test Configuration: 60S Injectors, Stock Muffler
Fuel: EM-163-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
3	24 mph	5.3	1.6	1.4	1.1	0.7
5	900 rpm	4.5	1.4	1.1	1.0	0.9
11	1/3 load*	4.2	1.2	1.2	1.0	0.8
15		3.9	1.3	0.9	1.0	0.7
	Average	4.5	1.4	1.2	1.0	0.8
4	32 mph	4.5	1.4	1.3	1.0	0.6
8	1200 rpm	4.7	1.5	1.3	0.9	0.8
12	1/2 load*	3.8	1.1	1.0	1.0	0.6
13		3.6	1.2	1.1	1.0	0.5
	Average	4.1	1.3	1.2	1.0	0.6
2	40 mph	4.8	1.5	1.0	1.0	0.9
6	1500 rpm	4.1	1.2	1.0	1.0	0.8
9	1/2 load*	4.1	1.2	1.0	1.0	0.9
16		4.1	1.3	1.0	1.0	0.7
	Average	4.3	1.3	1.0	1.0	0.8
1	Idle	4.5	1.4	1.1	1.1	0.8
7	Idle	5.0	1.7	1.0	1.0	0.9
10	Idle	4.5	1.5	0.9	1.2	1.0
14	Idle	4.9	1.5	1.2	1.2	1.0
	Average	4.7	1.5	1.1	1.1	0.9
17	Idle-Acceleration	5.5	1.8	1.5	1.1	1.1
19	Idle-Acceleration	5.9	2.0	1.6	1.2	1.3
22	Idle-Acceleration	6.3	2.0	1.4	1.4	1.5
24	Idle-Acceleration	6.1	2.0	1.8	1.1	1.1
	Average	6.0	2.0	1.6	1.2	1.3
18	Deceleration	5.7	2.0	1.3	1.3	1.3
20	Deceleration	5.8	2.0	1.4	1.1	1.2
21	Deceleration	6.3	2.0	1.4	1.4	1.1
23	Deceleration	5.7	2.0	1.3	1.1	1.2
	Average	5.9	2.0	1.4	1.2	1.2

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-7. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 707
Date: August 31, 1970

Test Configuration: L8N Injectors,
Catalytic Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
4	24 mph	1.9	0.8	0.7	0.5	0.1
6	900 rpm	2.5	0.8	1.0	0.9	0.0
12	1/2 load*	2.4	1.0	0.8	0.8	0.0
13		1.8	0.8	0.5	0.4	0.2
	Average	2.1	0.9	0.8	0.7	0.1
2	32 mph	3.2	1.0	0.5	1.0	0.3
5	1200 rpm	2.1	0.8	0.9	0.4	0.1
11	1/2 load*	2.2	0.8	0.8	0.6	0.0
15		2.5	1.0	0.9	0.6	0.1
	Average	2.5	0.9	0.8	0.7	0.1
3	40 mph	2.7	0.9	0.8	0.8	0.3
7	1500 rpm	3.2	1.0	0.8	0.9	0.6
9	1/2 load*	2.2	0.8	0.8	0.6	0.0
16		3.9	1.1	0.9	1.0	0.9
	Average	3.0	1.0	0.8	0.8	0.5
1	Idle	3.5	1.0	0.9	0.8	0.3
8	Idle	3.0	0.9	1.0	0.9	0.4
10	Idle	2.0	0.9	0.5	0.6	0.1
14	Idle	2.2	0.7	0.5	0.8	0.2
	Average	2.7	0.9	0.7	0.8	0.3
17	Idle-Acceleration	4.6	1.4	1.0	1.0	1.0
20	Idle-Acceleration	4.6	1.4	1.0	1.1	1.0
23	Idle-Acceleration	3.9	1.0	1.0	1.9	0.9
24	Idle-Acceleration	3.9	1.0	1.0	0.9	0.9
	Average	4.3	1.2	1.0	1.0	1.0
18	Deceleration	3.5	1.2	1.0	1.0	0.3
19	Deceleration	2.7	1.0	0.7	0.6	0.5
21	Deceleration	4.8	1.5	1.0	0.9	1.0
22	Deceleration	3.4	1.0	0.9	0.9	0.6
	Average	3.6	1.2	0.9	0.9	0.6

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-8. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 707
Date: September 1, 1970

Test Configuration: L8N Injectors,
Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
1	24 mph	4.1	1.1	1.0	0.8	0.9
7	900 rpm	2.9	1.0	0.6	0.7	0.2
11	1/2 load*	3.7	1.1	1.0	1.0	0.6
14		3.4	1.0	0.9	1.0	0.4
	Average	3.4	1.1	0.9	0.9	0.5
2	32 mph	3.3	1.0	1.0	1.0	0.4
8	1200 rpm	2.4	0.9	0.7	0.7	0.3
9	1/2 load*	3.3	1.0	0.9	0.8	0.4
15		3.3	1.0	0.9	0.9	0.4
	Average	3.1	1.0	0.9	0.9	0.4
3	40 mph	3.7	1.1	1.0	1.0	0.4
6	1500 rpm	4.5	1.3	1.0	0.8	0.9
12	1/2 load*	5.2	1.8	1.0	1.1	1.0
16		4.5	1.3	1.0	1.0	1.0
	Average	4.5	1.4	1.0	1.0	0.8
4	Idle	4.6	1.5	1.0	0.9	1.0
5	Idle	3.5	1.1	0.3	1.0	0.7
10	Idle	4.0	1.2	0.9	1.0	0.8
13	Idle	4.3	1.2	1.0	1.0	0.9
	Average	4.1	1.3	0.9	1.0	0.9
18	Idle-Acceleration	4.3	1.6	1.0	0.8	0.9
20	Idle-Acceleration	5.1	1.7	0.9	1.2	1.1
21	Idle-Acceleration	4.9	1.7	0.9	1.0	1.1
22	Idle-Acceleration	5.1	1.8	1.1	1.1	1.0
	Average	4.9	1.7	1.0	1.0	1.0
17	Deceleration	3.3	1.3	0.7	0.8	0.7
19	Deceleration	3.7	1.1	0.9	1.0	0.7
23	Deceleration	2.6	0.9	0.7	0.8	0.3
24	Deceleration	2.8	1.0	0.9	0.8	0.1
	Average	3.1	1.1	0.8	0.9	0.5

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-9. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 707
Date: September 3, 1970

Test Configuration: 605 Injectors, Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
2	24 mph	3.0	0.9	1.0	0.6	0.3
5	900 rpm	3.6	1.0	1.0	0.8	0.5
11	1/2 load*	4.4	1.1	1.0	0.9	0.6
14		5.5	1.4	1.4	0.9	1.0
	Average	4.1	1.1	1.1	0.8	0.6
1	32 mph	4.2	1.0	1.0	0.9	0.5
7	1200 rpm	4.7	1.2	1.1	0.9	0.6
12	1/2 load*	4.6	1.4	0.9	0.8	0.7
13		4.4	1.0	0.9	1.0	0.9
	Average	4.5	1.2	1.0	0.9	0.7
4	40 mph	6.0	1.9	1.2	1.0	1.0
8	1500 rpm	5.3	1.6	0.9	1.0	0.9
10	1/2 load*	5.5	1.6	1.1	0.9	0.9
15		5.4	1.6	1.0	0.8	1.0
	Average	5.6	1.7	1.0	0.9	1.0
3	Idle	5.6	1.7	1.0	1.0	1.0
6	Idle	5.3	1.7	1.0	1.0	0.8
9	Idle	5.1	1.8	1.0	1.0	0.7
16	Idle	6.6	1.9	1.4	1.1	1.2
	Average	5.7	1.7	1.1	1.0	0.9
17	Idle-Acceleration	6.8	1.8	1.3	0.9	1.7
20	Idle-Acceleration	6.1	1.8	1.1	0.8	1.4
22	Idle-Acceleration	7.4	2.0	1.6	1.1	1.7
23	Idle-Acceleration	6.9	2.0	1.3	1.2	1.5
	Average	6.8	1.9	1.3	1.0	1.6
18	Deceleration	7.6	2.0	1.3	1.3	1.9
19	Deceleration	6.8	2.0	1.3	1.3	1.4
21	Deceleration	6.8	2.1	1.1	1.2	1.5
24	Deceleration	7.8	2.0	1.4	1.5	1.9
	Average	7.3	2.0	1.3	1.3	1.7

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-10. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 702
Date: April 27, 1971

Test Configuration: L2N Injectors, Catalytic Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
2	23 mph	2,0	0,9	0,6	0,5	0,0
7	900 rpm	2,1	0,8	0,6	0,6	0,3
10	1/2 load*	2,9	1,0	0,8	0,9	0,6
13		3,0	0,9	1,0	0,9	0,3
	Average	2,5	0,9	0,7	0,7	0,4
4	30 mph	1,6	0,9	0,6	0,1	0,1
8	1200 rpm	2,3	1,0	0,6	0,5	0,3
11	1/2 load*	3,8	1,0	1,0	0,9	0,9
16		3,0	1,0	1,0	0,6	0,5
	Average	2,7	1,0	0,8	0,5	0,5
3	36 mph	2,0	0,9	0,6	0,3	0,3
5	1500 rpm	3,0	1,0	0,6	0,6	0,8
12	1/2 load*	3,9	1,3	1,0	0,9	0,9
15		2,9	1,0	1,0	0,5	0,5
	Average	3,0	1,1	0,8	0,6	0,6
1	Idle	2,6	0,8	0,8	0,9	0,0
6	Idle	2,5	0,9	0,8	0,8	0,1
9	Idle	3,9	1,2	1,0	0,8	1,0
14	Idle	3,6	1,0	1,0	0,9	0,8
	Average	3,2	1,0	0,9	0,9	0,5
18	Idle-Acceleration	3,9	1,2	1,0	1,0	0,9
20	Idle-Acceleration	3,5	1,0	0,9	0,9	0,8
22	Idle-Acceleration	4,3	1,5	1,0	1,0	0,8
24	Idle-Acceleration	3,6	1,3	1,0	0,9	0,8
	Average	3,8	1,3	1,0	1,0	0,8
17	Deceleration	2,8	1,0	0,9	0,8	0,4
19	Deceleration	3,6	1,0	1,0	1,0	0,8
21	Deceleration	4,3	1,6	1,0	0,9	0,6
23	Deceleration	3,9	1,0	1,0	1,0	0,8
	Average	3,7	1,2	1,0	0,9	0,7

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-11. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 702
Date: April 28, 1971

Test Configuration: LSN Injectors,
Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
3	23 mph	2.0	0.6	0.9	0.5	0.1
7	900 rpm	3.4	0.9	1.0	1.0	0.6
12	1/2 load*	2.3	0.7	0.6	0.9	0.3
14		3.1	1.0	0.9	0.9	0.6
	Average	2.7	0.8	0.9	0.9	0.4
4	30 mph	2.1	0.9	0.7	0.4	0.1
5	1200 rpm	2.4	0.7	0.7	0.7	0.4
11	1/2 load*	2.4	0.6	0.9	0.9	0.3
15		2.6	1.0	0.9	0.7	0.3
	Average	2.4	0.8	0.8	0.7	0.3
2	36 mph	2.9	1.0	1.0	0.7	0.1
8	1500 rpm	3.7	1.1	1.0	1.0	0.7
10	1/2 load*	3.4	1.0	1.0	1.0	0.4
16		3.4	1.0	1.0	0.9	0.7
	Average	3.6	1.0	1.0	0.9	0.5
1	Idle	2.4	1.0	0.9	0.4	0.1
6	Idle	3.7	1.0	1.0	1.0	0.7
9	Idle	3.7	1.0	1.0	1.0	0.6
13	Idle	3.4	0.9	1.0	0.7	0.6
	Average	3.3	1.0	1.0	0.8	0.5
18	Idle-Acceleration	5.0	1.9	1.1	1.0	0.9
20	Idle-Acceleration	5.4	1.9	1.4	1.0	1.3
23	Idle-Acceleration	4.6	1.6	1.0	1.0	1.0
24	Idle-Acceleration	4.7	1.6	1.0	1.0	1.1
	Average	4.9	1.8	1.1	1.0	1.1
17	Deceleration	4.7	1.6	1.0	1.0	1.0
19	Deceleration	4.4	1.1	1.1	1.0	1.0
21	Deceleration	4.4	1.1	1.1	1.0	1.0
22	Deceleration	4.3	1.1	1.0	1.0	1.0
	Average	4.5	1.2	1.1	1.0	1.0

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-12. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 702
Date: April 30, 1971

Test Configuration: 60S Injectors,
Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
3	25 mph	5,8	1,9	1,8	0,9	1,2
8	900 rpm	5,0	1,5	1,2	1,0	1,0
11	1/2 load*	4,5	1,3	1,0	1,0	1,0
15		4,5	1,5	1,0	1,0	1,0
	Average	5,0	1,6	1,3	1,0	1,1
4	30 mph	4,6	1,4	1,3	0,9	1,0
6	1200 rpm	5,1	1,5	1,4	1,0	1,0
12	1/2 load*	4,3	1,3	1,0	1,0	1,0
16		4,4	1,2	1,0	1,0	1,0
	Average	4,6	1,4	1,2	1,0	1,0
1	36 mph	4,9	1,5	1,3	1,0	1,0
7	1500 rpm	4,1	1,0	1,3	1,0	1,0
10	1/2 load*	5,3	1,8	1,2	1,0	1,0
13		4,6	1,6	1,0	1,0	1,0
	Average	4,7	1,5	1,2	1,0	1,0
2	Idle	4,6	1,4	1,0	0,9	1,0
5	Idle	4,3	1,4	1,2	1,0	1,0
9	Idle	4,3	1,0	1,0	1,0	1,0
14	Idle	5,1	1,9	1,0	1,0	1,0
	Average	4,6	1,4	1,1	1,0	1,0
17	Idle-Acceleration	6,6	2,0	1,5	1,0	1,9
20	Idle-Acceleration	7,3	2,1	2,0	1,2	1,7
21	Idle-Acceleration	7,5	2,3	1,9	1,2	2,0
23	Idle-Acceleration	6,8	2,1	1,5	0,9	1,9
	Average	7,1	2,1	1,7	1,1	1,9
18	Deceleration	6,4	2,0	1,5	1,3	1,6
19	Deceleration	6,1	2,0	1,3	[illegible]	1,8
22	Deceleration	6,3	2,0	1,6	1,2	1,5
23	Deceleration	6,8	2,1	1,5	0,9	1,9
	Average	6,4	2,0	1,5	1,2	1,7

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-13. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 704
Date: April 13, 1971

Test Configuration: L8N Injectors,
Catalytic Muffler
Fuel: EM-165-F (*No. 1 Diesel*)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
3	23 mph	3,4	1,2	1,0	0,7	0,6
5	900 rpm	2,6	0,8	1,0	0,4	0,3
10	1/2 load*	2,0	0,9	0,8	0,6	0,0
13		2,8	0,9	1,0	0,8	0,2
	Average	2,7	1,0	1,0	0,6	0,3
1	30 mph	2,3	1,0	0,9	0,2	0,1
8	1200 rpm	2,6	0,9	0,7	0,8	0,3
9	1/2 load*	4,6	1,6	1,2	1,0	[illegible]
16		2,8	0,9	1,0	0,8	0,3
	Average	3,1	1,1	1,0	0,7	[illegible]
4	37 mph	4,6	1,6	1,1	0,8	[illegible]
6	1500 rpm	3,6	1,0	1,0	0,8	0,3
11	1/2 load*	4,1	1,2	1,0	1,0	0,8
15		4,0	1,3	1,0	1,0	0,8
	Average	4,1	1,3	1,0	0,9	0,8
2	Idle	3,0	0,9	1,0	0,9	[illegible]
7	Idle	3,2	1,1	0,9	0,7	0,6
12	Idle	3,0	0,9	0,9	0,6	0,4
14	Idle	3,3	1,0	1,0	0,9	0,6
	Average	3,1	1,0	1,0	0,8	0,5
17	Idle-Acceleration	4,0	1,3	1,0	1,0	0,7
19	Idle-Acceleration	4,9	2,0	1,2	1,0	1,0
22	Idle-Acceleration	4,9	1,8	1,1	1,0	1,0
23	Idle-Acceleration	5,0	1,8	1,3	1,0	0,9
	Average	4,7	1,7	1,2	1,0	0,9
18	Deceleration	2,7	1,1	1,0	0,3	0,1
20	Deceleration	3,1	1,1	0,9	0,8	0,3
21	Deceleration	2,9	1,0	1,0	0,3	0,6
24	Deceleration	3,1	1,0	1,0	0,7	0,3
		3,0	1,1	1,0	0,5	0,3

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-14. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 704
Date: April 14, 1971

Test Configuration: L8N Injectors, Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
4	23 mph	2.7	0.9	1.0	0.7	0.2
7	900 rpm	3.2	1.0	1.0	0.8	0.3
11	1/2 load*	2.4	1.0	0.9	0.5	0.0
13		2.5	0.9	0.9	0.6	0.4
	Average	2.7	1.0	1.0	0.7	0.2
3	30 mph	2.5	0.9	0.9	0.5	0.2
5	1200 rpm	2.5	0.9	0.9	0.3	0.3
10	1/2 load*	4.6	1.4	1.0	1.0	1.0
15		3.7	1.0	1.0	1.0	0.6
	Average	3.3	1.1	1.0	0.7	0.5
2	37 mph	3.6	1.0	1.0	0.9	0.6
8	1500 rpm	3.3	1.1	1.0	0.8	0.3
12	1/2 load*	3.5	1.1	0.9	1.0	0.5
16		3.1	1.0	1.0	0.6	0.5
	Average	3.4	1.1	1.0	0.8	0.5
1	Idle	3.5	1.0	0.9	0.6	0.9
6	Idle	3.6	1.0	0.8	1.0	0.9
9	Idle	4.0	1.1	1.0	1.0	0.8
14	Idle	4.1	1.4	1.0	0.9	0.9
		3.8	1.1	0.9	0.9	0.9
17	Idle-Acceleration	4.8	1.8	1.1	1.0	0.8
18	Idle-Acceleration	5.0	1.8	1.0	1.2	0.8
23	Idle-Acceleration	3.8	1.0	1.0	0.8	1.0
24	Idle-Acceleration	3.9	1.1	1.0	0.9	0.8
	Average	4.4	1.4	1.0	1.0	0.9
19	Deceleration	3.2	1.0	1.0	0.8	0.3
20	Deceleration	3.1	1.0	1.0	0.9	0.3
21	Deceleration	2.2	0.9	0.9	0.4	0.0
22	Deceleration	2.1	1.0	0.9	0.4	0.3
	Average	2.6	1.0	1.0	0.6	0.2

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-15. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 704
Date: April 16, 1971

Test Configuration: 608 Injector,
Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
2	23 mph	5,0	1,8	1,1	1,0	1,0
7	900 rpm	3,6	1,0	1,0	0,9	0,4
11	1/2 load*	4,8	1,8	1,1	1,0	0,9
16		4,3	1,1	1,2	1,0	1,0
	Average	4,4	1,4	1,1	1,0	0,8
3	30 mph	4,8	1,7	1,1	1,0	1,0
8	1200 rpm	4,1	1,1	1,0	1,0	1,0
10	1/2 load*	5,6	1,6	1,1	1,0	0,9
14		4,4	1,7	1,0	1,0	0,8
	Average	4,7	1,5	1,1	1,0	0,9
4	37 mph	4,1	1,1	1,0	1,0	1,0
5	1500 rpm	4,0	1,1	1,0	1,0	0,9
12	1/2 load*	4,1	1,3	1,0	1,0	0,8
15		3,8	1,1	1,1	0,8	0,8
	Average	4,0	1,2	1,0	1,0	0,9
1	Idle	4,1	1,0	1,0	1,0	0,9
6	Idle	3,4	1,1	0,9	0,9	0,4
9	Idle	3,2	1,0	1,0	0,9	0,7
13	Idle	5,0	1,7	1,2	0,9	1,1
	Average	3,9	1,2	1,0	0,9	0,8
18	Idle-Acceleration	6,6	2,0	1,8	1,1	1,8
19	Idle-Acceleration	5,9	2,0	1,6	1,0	1,2
23	Idle-Acceleration	6,5	2,2	1,8	1,3	1,7
24	Idle-Acceleration	6,1	2,1	1,7	1,1	1,1
	Average	6,3	2,1	1,7	1,1	1,5
17	Deceleration	5,8	1,9	1,7	1,1	1,1
20	Deceleration	6,0	2,0	1,3	1,2	1,6
21	Deceleration	6,0	2,1	1,6	1,1	1,3
22	Deceleration	5,6	2,0	1,1	1,2	1,3
	Average	5,9	2,0	1,4	1,2	1,3

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-16. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 707
Date: March 30, 1971

Test Configuration: LSN Injectors,
Catalytic Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
2	23 mph	3.8	1.0	1.0	0.9	0.8
5	900 rpm	2.7	1.1	0.9	0.6	0.1
11	1/2 load*	2.3	0.8	1.0	0.5	0.1
14		2.9	1.0	1.0	0.7	0.3
	Average	2.9	1.0	1.0	0.7	0.3
1	30 mph	3.6	1.1	1.0	0.7	0.8
7	1200 rpm	4.3	1.3	1.0	0.9	0.9
12	1/2 load*	2.8	0.9	1.0	0.6	0.4
13		3.0	0.9	1.0	0.5	0.5
	Average	3.4	1.1	1.0	0.7	0.7
3	38 mph	4.1	1.2	1.0	1.0	0.9
8	1500 rpm	4.1	1.3	1.0	1.0	0.8
10	1/2 load*	4.9	1.7	0.9	1.0	0.9
15		3.4	1.1	1.0	0.7	0.6
	Average	4.1	1.3	1.0	0.9	0.8
4	Idle	3.2	1.0	1.0	0.8	0.5
6	Idle	3.1	1.0	0.9	0.6	0.6
9	Idle	3.9	1.1	1.0	0.8	0.8
16	Idle	2.8	1.0	0.8	0.8	0.3
	Average	3.3	1.0	0.9	0.8	0.6
17	Idle-Acceleration	4.6	1.5	1.0	1.0	0.9
20	Idle-Acceleration	4.5	1.4	1.0	1.0	1.1
22	Idle-Acceleration	4.3	1.3	1.0	0.9	0.7
23	Idle-Acceleration	4.0	1.3	1.0	0.9	0.7
	Average	4.4	1.4	1.0	1.0	0.9
18	Deceleration	1.3	0.8	0.4	0.3	0.1
19	Deceleration	2.0	0.9	0.6	0.4	0.0
21	Deceleration	2.7	1.0	0.8	0.9	0.2
24	Deceleration	3.1	1.0	1.0	0.8	0.2
	Average	2.3	0.9	0.7	0.6	0.1

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-17. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 707
Date: March 31, 1971

Test Configuration: LSN Injectors, Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
3	33 mph	3, 0	1, 0	0, 8	[illegible]	0, 3
5	900 rpm	3, 4	1, 1	1, 0	1, 0	0, 4
11	1/2 load*	2, 2	0, 8	0, 7	0, 8	0, 0
15		2, 2	0, 9	0, 6	0, 5	0, 2
	Average	2, 7	1, 0	0, 8	0, 6	0, 2
2	30 mph	3, 9	1, 0	1, 0	1, 0	0, 9
8	1200 rpm	3, 4	1, 1	0, 9	0, 8	0, 7
9	1/2 load*	4, 1	1, 1	1, 0	1, 0	0, 8
16		3, 3	1, 0	1, 0	1, 0	0, 3
	Average	3, 7	1, 1	1, 0	1, 0	0, 7
4	38 mph	4, 4	1, 4	1, 0	1, 0	0, 8
7	1500 rpm	4, 5	1, 4	1, 0	1, 0	0, 9
10	1/2 load*	3, 5	0, 9	1, 0	1, 0	0, 6
14		4, 6	1, 5	1, 0	1, 0	0, 8
	Average	4, 3	1, 3	1, 0	1, 0	0, 8
1	Idle	3, 0	1, 0	1, 0	0, 8	0, 4
6	Idle	3, 8	1, 1	1, 0	1, 0	0, 6
12	Idle	2, 6	0, 8	0, 9	0, 5	0, 3
13	Idle	3, 1	0, 9	0, 9	0, 9	0, 3
	Average	3, 1	1, 0	1, 0	0, 8	0, 4
17	Idle-Acceleration	3, 8	1, 5	0, 6	0, 8	0, 7
20	Idle-Acceleration	4, 8	1, 8	0, 9	0, 9	0, 9
22	Idle-Acceleration	4, 9	1, 6	1, 1	1, 0	1, 2
24	Idle-Acceleration	4, 9	1, 8	1, 1	1, 0	1, 0
	Average	4, 6	1, 7	0, 9	0, 9	1, 0
18	Deceleration	3, 1	1, 0	0, 8	0, 9	0, 5
19	Deceleration	2, 0	0, 7	0, 6	0, 7	0, 1
21	Deceleration	3, 1	0, 9	0, 9	0, 7	0, 4
23	Deceleration	3, 8	1, 0	0, 8	0, 6	0, 4
	Average	3, 0	0, 9	0, 8	0, 7	0, 4

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

TABLE B-18. VEHICLE ODOR EVALUATION SUMMARY

Vehicle: Bus 707
Date: April 2, 1971

Test Configuration: 608 Injectors,
Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Run No.	Operating Conditions	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
2	23 mph	5,6	1,9	1,7	0,9	1,1
5	900 rpm	5,0	1,7	1,2	1,0	1,0
12	1/2 load*	4,3	1,4	1,1	0,9	0,9
13		4,0	1,1	1,0	1,0	0,9
	Average	4,7	1,5	1,3	1,0	1,0
3	30 mph	5,6	1,9	1,4	1,3	1,0
8	1200 rpm	4,4	1,4	1,1	0,9	1,0
10	1/2 load*	4,7	1,7	1,1	1,0	0,9
15		4,7	1,8	1,0	1,0	1,0
	Average	4,9	1,7	1,2	1,1	1,0
4	37 mph	5,6	1,9	1,4	1,0	1,1
7	1500 rpm	5,3	1,9	1,4	0,9	1,0
11	1/2 load*	4,2	1,2	1,0	1,0	0,9
16		4,4	1,4	0,9	1,0	1,0
	Average	4,9	1,6	1,2	1,0	1,0
1	Idle	4,0	1,2	1,1	1,0	0,7
6	Idle	4,3	1,2	0,9	1,0	1,1
9	Idle	3,9	1,0	1,0	1,0	0,8
14	Idle	4,2	1,2	1,0	1,0	1,0
	Average	4,1	1,2	1,0	1,0	0,9
17	Idle-Acceleration	5,7	2,0	1,4	0,9	1,3
20	Idle-Acceleration	5,7	2,0	1,6	1,0	1,4
22	Idle-Acceleration	5,2	1,8	1,2	1,0	1,0
23	Idle-Acceleration	5,2	1,8	1,1	1,0	1,1
	Average	5,5	1,9	1,3	1,0	1,2
18	Deceleration	5,9	2,0	1,6	0,9	1,4
19	Deceleration	5,2	1,9	1,1	1,1	1,2
21	Deceleration	5,3	2,0	1,3	1,1	1,0
24	Deceleration	5,8	1,9	1,2	1,2	1,6
	Average	5,6	2,0	1,3	1,1	1,3

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*Engine operated at a fuel rate midway between maximum and no load fuel rate.

APPENDIX C

GASEOUS EMISSIONS DATA TAKEN DURING ODOR TESTS

TABLE C-1. EXHAUST EMISSIONS SUMMARY

Bus: [illegible]
Date: September 18, 1978

Test Configuration: [illegible] Injectors, Catalytic Muffler
Fuel: EM-[illegible]-F (No. 1 Diesel)

Condition	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO_2, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic Aldehydes, ppm[b]
25 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
600 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load[a]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1200 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load[a]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
45 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load[a]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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[a] Engine operated at fuel rate midway between maximum and no load fuel rate.
[b] As ppm formaldehyde.

TABLE C-2. EXHAUST EMISSIONS SUMMARY

Bus: [illegible]
Date: September [illegible], 1978

Test Configuration: [illegible] Injectors, Stock Muffler
Fuel: EM-[illegible]-F (No. 1 Diesel)

Condition	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO_2, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic Aldehydes, ppm[b]
25 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
600 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load[a]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1200 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load[a]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
45 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load[a]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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[a] Engine operated at fuel rate midway between maximum and no load fuel rate.
[b] As ppm formaldehyde.

TABLE C-3. EXHAUST EMISSIONS SUMMARY

Run: [illegible]
Date: October 1, 1976

Test Configuration: [illegible] Injectors, [illegible] Muffler
Fuel: FM-[illegible] (No. 1 Diesel)

Condition	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO_2, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic Aldehydes, ppm†
24 mph 900 rpm 1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
32 mph 1200 rpm 1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40 mph 1500 rpm 1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Engine operated at fuel rate midway between maximum and no load fuel rate.
†As ppm formaldehyde.

TABLE C-4. EXHAUST EMISSIONS SUMMARY

Run: [illegible]
Date: September [illegible], 1976

Test Configuration: [illegible] Injectors, Catalytic Muffler
Fuel: FM-[illegible] (No. 1 Diesel)

Condition	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO_2, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic Aldehydes, ppm†
24 mph 900 rpm 1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
32 mph 1200 rpm 1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40 mph 1500 rpm 1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Engine operated at fuel rate midway between maximum and no load fuel rate.
†As ppm formaldehyde.

TABLE C-5. EXHAUST EMISSIONS SUMMARY

Bus: [illegible]
Date: September 15, 1979

Test Configuration: [illegible] Injectors, Stock Muffler
Fuel: EM-[illegible]-F (No. 1 Diesel)

Conditions	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO_2, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
25 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
900 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1200 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-6. EXHAUST EMISSIONS SUMMARY

Bus: [illegible]
Date: September 17, 1979

Test Configuration: [illegible] Injectors, Stock Muffler
Fuel: EM-[illegible]-F (No. 1 Diesel)

Conditions	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO_2, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
25 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
900 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1200 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-7. EXHAUST EMISSIONS SUMMARY

Bus: 107
Date: August 31, 1978

Test Configuration: LBR Injectors,
Catalytic Muffler
Fuel: EM-165-F (No. 1 Diesel)

Conditions	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO_2, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
16 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
32 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1000 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
48 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-8. EXHAUST EMISSIONS SUMMARY

Bus: 107
Date: September 1, 1978

Test Configuration: LBR Injectors,
Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Conditions	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO_2, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
16 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
32 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1000 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
48 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-9. EXHAUST EMISSIONS SUMMARY

Rig: 707
Date: September 3, 1970

Test Configuration: 600 Injectors, Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Condition	Run No.	HC, ppm C	CO, ppm	NO, ppm	CO$_2$, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
25 mph	2	1473	158	735	4.8	0.7	5.8	16.8
600 rpm	3	1393	142	735	4.7	0.7	7.5	18.0
1/2 load*	11	1220	158	778	4.7	0.7	6.3	20.0
	16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35 mph	1	1987	123	720	4.8	0.7	6.8	17.6
1200 rpm	7	1266	133	749	4.7	0.7	7.6	16.2
1/2 load*	12	1140	143	733	4.8	1.0	6.3	19.8
	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
55 mph	4	1197	161	861	5.4	1.0	9.2	21.2
1500 rpm	5	1178	161	808	5.1	1.1	9.3	21.2
1/2 load*	10	1151	162	877	5.2	0.9	9.3	22.2
	13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	3	737	152	164	1.4	1.1	9.3	20.2
Idle	6	668	158	163	1.4	1.2	10.5	21.0
Idle	9	685	158	178	1.4	1.2	10.7	21.2
Idle	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-10. EXHAUST EMISSIONS SUMMARY

Rig: 702
Date: April 27, 1971

Test Configuration: 600 Injectors, Catalytic Muffler
Fuel: EM-165-F (No. 1 Diesel)

Condition	Run No.	HC, ppm C	CO, ppm	NO, ppm	CO$_2$, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
25 mph	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
600 rpm	7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35 mph	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1200 rpm	8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
55 mph	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-11. EXHAUST EMISSIONS SUMMARY

Bus: [illegible]
Date: April 26, 1971

Test Configuration: [illegible] Injectors;
Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Condition	Run No.	HC, ppm C	CO, ppm	NO, ppm	CO$_2$, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
12 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
700 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17% load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1200 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17% load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17% load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-12. EXHAUST EMISSIONS SUMMARY

Bus: [illegible]
Date: April 19, 1971

Test Configuration: [illegible] Injectors;
Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Condition	Run No.	HC, ppm C	CO, ppm	NO, ppm	CO$_2$, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
12 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
700 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17% load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1200 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17% load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17% load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-13. EXHAUST EMISSIONS SUMMARY

Run: [illegible]
Date: April 13, 1971

Test Configuration: [illegible] Injectors, Catalytic Muffler
Fuel: EM-[illegible]-F (No. 1 Diesel)

Conditions	Run No.	HC, ppm C	CO, ppm	NO, ppm	CO₂, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
[illegible] mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-14. EXHAUST EMISSIONS SUMMARY

Run: [illegible]
Date: April 14, 1971

Test Configuration: [illegible] Injectors, Stock Muffler
Fuel: EM-[illegible]-F (No. 1 Diesel)

Conditions	Run No.	HC, ppm C	CO, ppm	NO, ppm	CO₂, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
[illegible] mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-15. EXHAUST EMISSIONS SUMMARY

Run: [illegible]
Date: April [illegible], 1971

Test Configuration: [illegible] Injectors,
Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

Condition	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO$_2$, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
25 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
750 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1200 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
67 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-16. EXHAUST EMISSIONS SUMMARY

Run: [illegible]
Date: March [illegible], 1971

Test Configuration: [illegible] Injectors,
Catalytic Muffler
Fuel: EM-165-F (No. 1 Diesel)

Condition	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO$_2$, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
25 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
750 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1200 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
67 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-17. EXHAUST EMISSIONS SUMMARY

Rig: 107
Date: March 31, 1971

Test Configuration: LBM Injectors, Stock Muffler
Fuel: EM-151-F (No. 1 Diesel)

Condition	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO2, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
25 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1000 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
45 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

TABLE C-18. EXHAUST EMISSIONS SUMMARY

Rig: 107
Date: April 2, 1971

Test Configuration: LBM Injectors, Stock Muffler
Fuel: EM-151-F (No. 1 Diesel)

Condition	Run No.	HC, ppmC	CO, ppm	NO, ppm	CO2, %	Acrolein, ppm	Formaldehyde, ppm	Aliphatic† Aldehydes, ppm
25 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1000 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
45 mph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500 rpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2 load*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Idle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
As-measured avg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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*Engine operated at fuel rate midway between maximum and no load fuel rates.
†As ppm formaldehyde.

APPENDIX D

GASEOUS EMISSIONS, 13-MODE CYCLE

TABLE D-1. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 9/15/70 Test Miles: 1758 Test Configuration: 60LSN + Cat. Muff.
Bus: 702 Test Hours: 142 Fuel: EM-165-F (No. 1 Diesel)

RUN 1

Mode	C_6H_{14}, ppm	CO, ppm	NO, ppm	Engine Speed, rpm	Observed Power, bhp	Air Flow, lb/min	Fuel Flow, lb/min	Exhaust Flow, lb/min	gm/hr C_6H_{14} (weighted)	gm/hr CO (weighted)	gm/hr NO (weighted)	Observed bhp (weighted)
1	230	219	190	Idle	●	12.88	.07	12.95	2.62	4.72	2.63	●
2	[illegible]	[illegible]	77	1000	●	20.42	.18	20.60	5.26	7.41	7.67	●
3	261	119	417	"	22.5	21.45	.21	20.66	5.73	5.15	19.11	1.50
4	245	95	563	"	45.0	20.40	.30	20.70	5.11	4.14	[illegible]	3.60
5	[illegible]	95	597	"	67.5	20.30	.44	20.74	6.30	4.14	41.97	5.40
6	277	1417	1163	"	90	20.30	.61	20.91	6.56	62.43	79.96	7.20
7	209	143	257	Idle	●	12.88	.07	12.95	2.36	3.25	5.83	●
8	262	242	1020	1600	136	33.83	.85	34.68	8.86	17.66	71.80	10.88
9	196	95	747	"	102	33.80	.67	34.47	7.14	6.89	58.25	8.16
10	207	71	549	"	68	33.85	.50	34.35	7.37	5.13	42.74	5.44
11	219	95	343	"	34	33.90	.33	34.23	7.92	6.84	26.49	2.72
12	220	95	304	"	●	34.10	.26	34.36	7.74	6.86	23.77	●
13	210	143	240	Idle	●	12.88	.07	12.95	2.61	3.24	5.93	●
								TOTALS	76.85	140.10	397.24	45.20

RUN 2

Mode	C_6H_{14}, ppm	CO, ppm	NO, ppm	Engine Speed, rpm	Observed Power, bhp	Air Flow, lb/min	Fuel Flow, lb/min	Exhaust Flow, lb/min	gm/hr C_6H_{14} (weighted)	gm/hr CO (weighted)	gm/hr NO (weighted)	Observed bhp (weighted)
1	196	192	154	Idle	●	12.72	.07	12.79	2.24	4.38	5.76	●
2	219	242	143	1000	●	20.44	.18	20.57	4.76	10.47	6.64	●
3	230	119	390	"	22.5	20.40	.22	20.62	5.01	5.16	17.21	1.50
4	230	95	507	"	45.0	20.38	.30	20.68	5.02	4.14	33.86	3.60
5	253	95	808	"	67.5	20.35	.43	20.78	5.53	4.15	39.88	5.40
6	265	1202	1033	"	90.0	20.30	.62	20.92	5.86	52.90	81.11	7.20
7	196	143	215	Idle	●	12.88	.07	12.95	2.23	3.25	5.64	●
8	219	217	974	1600	136	33.92	.87	34.67	8.02	15.84	76.82	10.88
9	196	71	764	"	102	33.36	.66	34.02	7.18	5.16	59.73	8.16
10	196	71	549	"	68	33.72	.50	34.44	7.13	5.14	42.13	5.44
11	219	95	330		34	34.00	.33	34.33	7.94	6.86	25.76	2.72
12	219	95	291	"	●	34.09	.37	34.48	7.97	6.89	22.62	●
13	207	167	227	Idle	●	12.88	.07	12.95	2.35	3.81	5.52	●
								TOTALS	71.23	138.16	398.03	45.20

		RUN 1	RUN 2
gm/hr C_6H_{14} = 0.0156 (ppm C_6H_{14})(Exh. Flow, lb/min)(Weight Factor)	BSHC, gm/bhp hr	1.70	1.57
gm/hr CO = 0.0165 (ppm CO)(Exh. Flow, lb/min)(Weight Factor)	BSCO, gm/bhp hr	3.07	3.11
gm/hr NO = 0.0782 (ppm NO)(Exh. Flow, lb/min)(Weight Factor)	BSNO, gm/bhp hr	8.79	8.81

TABLE D-3. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 9/30/70 Test Miles: 1788 Test Configuration: 60LSN + Stock Muff.
Bus: 702 Test Hours: 142 Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C6H14, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C6H14 (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	288	217	178	Idle	0	12.90	.07	12.97	3.29	4.96	4.34	0
2	288	217	178	1000	0	20.30	.15	20.45	6.38	9.43	8.30	0
3	263	143	410	"	22.5	20.40	.21	20.61	5.72	6.80	19.76	1.80
4	253	95	577	"	45.0	20.38	.32	20.70	5.58	4.14	26.89	3.60
5	311	119	877	"	67.5	20.32	.45	20.77	6.82	5.20	42.03	5.40
6	368	1386	1146	"	90.0	20.29	.63	20.92	8.15	59.67	54.09	7.20
7	276	192	288	Idle	0	12.81	.07	12.88	3.15	4.34	6.10	0
8	288	217	1051	1600	136	34.10	.86	34.96	10.63	15.96	82.96	10.88
9	265	95	882	"	102	34.10	.68	34.78	9.74	6.48	69.41	8.16
10	253	71	591	"	68	34.10	.47	34.57	9.24	5.17	46.12	5.44
11	265	95	383	"	34	34.30	.35	34.65	9.66	6.90	29.93	2.72
12	265	95	370	"	0	34.30	.36	34.66	9.70	6.93	28.93	0
13	311	167	245	Idle	0	12.80	.07	12.87	3.52	3.77	6.42	0
								TOTALS	91.37	139.62	444.21	47.30

RUN 2

MODE	C6H14, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C6H14 (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	276	217	166	Idle	0	12.90	.07	12.97	3.15	4.96	4.05	0
2	265	217	166	1000	0	20.50	.14	20.64	5.78	9.42	7.30	0
3	230	119	424	"	22.5	20.45	.21	20.66	5.02	5.18	19.76	1.80
4	242	95	577	"	45.0	20.45	.32	20.77	5.30	4.15	27.04	3.60
5	253	95	913	"	67.5	20.40	.45	20.85	5.59	4.17	42.74	5.40
6	322	1142	1179	"	90.0	20.40	.62	21.02	7.14	50.50	55.92	7.20
7	265	169	252	Idle	0	12.85	.07	12.92	3.01	3.81	6.16	0
8	276	192	1073	1600	136	34.15	.86	35.01	10.20	14.14	85.84	10.88
9	242	71	877	"	102	34.20	.67	34.87	8.91	5.21	70.37	8.16
10	242	71	605	"	68	34.25	.47	34.72	8.87	5.19	48.40	5.44
11	253	95	383	"	34	34.30	.33	34.63	9.26	6.92	29.92	2.72
12	242	95	370	"	0	34.30	.35	34.65	8.86	6.93	28.73	0
13	265	168	265	Idle	0	12.83	.07	12.90	3.01	3.80	6.47	0
								TOTALS	84.08	124.86	[illegible]	[illegible]

		RUN 1	RUN 2
g/hr C_6H_{14} = 0.0152(ppm C_6H_{14})(EXH. FLOW, lb/min)(Weight Factor)	BSHC, g/bhp hr	2.02	1.96
g/hr CO = 0.0755(ppm CO)(EXH. FLOW, lb/min)(Weight Factor)	BSCO, g/bhp hr	3.08	2.95
g/hr NO = 0.0782(ppm NO)(EXH. FLOW, lb/min)(Weight Factor)	BSNO, g/bhp hr	9.38	7.56

TABLE D-3. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 10/2/70 Test Miles: 1758 Test Configuration: 60S + Stock Muffler
Bus: 702 Test Hours: 142 Fuel: EM-155-F (No. 1 Diesel)

RUN 1

Mode	C_6H_{14}, ppm	CO, ppm	NO, ppm	Engine Speed, rpm	Observed Power, bhp	Air Flow, lb/min	Fuel Flow, lb/min	Exhaust Flow, lb/min	gm C_6H_{14} (weighted)	gm CO (weighted)	gm NO (weighted)	Observed bhp (weighted)
1	760	237	202	Idle	—	12.88	.07	12.95	5.66	3.38	4.92	—
2	1170	310	178	1000	—	20.50	.13	20.63	27.57	13.63	8.27	—
3	1965	237	270	"	24.5	20.50	.25	20.75	40.86	10.54	19.11	1.96
4	1934	221	645	"	49	20.50	.37	20.87	42.63	9.70	86.81	3.92
5	1773	732	958	"	73.5	20.48	.54	21.02	39.35	32.38	45.43	5.88
6	1634	3437	1081	"	98	20.44	.68	21.12	36.44	152.73	50.08	7.84
7	668	221	215	Idle	—	12.84	.07	12.91	7.37	3.00	3.22	—
8	1450	769	1035	1600	143	34.10	.95	35.05	9.10	96.64	81.84	11.44
9	1611	176	828	"	107	34.10	.75	34.85	53.67	12.90	64.98	8.56
10	1611	176	535	"	71.5	34.20	.55	34.75	59.12	12.87	41.94	5.72
11	1800	237	317	"	36	34.30	.37	34.67	65.90	17.29	24.79	2.88
12	1750	237	304	"	—	34.30	.36	34.66	64.05	17.28	23.77	—
13	676	221	215	Idle	—	12.80	.07	12.87	7.43	4.77	3.20	—
								TOTALS	460.37	351.12	402.84	48.40

RUN 2

Mode	C_6H_{14}, ppm	CO, ppm	NO, ppm	Engine Speed, rpm	Observed Power, bhp	Air Flow, lb/min	Fuel Flow, lb/min	Exhaust Flow, lb/min	gm C_6H_{14} (weighted)	gm CO (weighted)	gm NO (weighted)	Observed bhp (weighted)
1	622	237	166	Idle	—	12.94	.07	13.01	9.12	3.41	4.06	—
2	990	346	184	1000	—	20.60	.13	20.73	21.67	15.09	6.64	—
3	1727	237	373	"	24.5	20.60	.22	20.82	37.77	10.38	17.21	1.96
4	1727	206	591	"	49	20.50	.38	20.88	38.09	9.05	23.66	3.92
5	1542	841	965	"	73.5	20.40	.54	20.94	34.10	37.06	44.84	5.88
6	1450	3790	987	"	98	20.40	.68	21.08	32.28	168.10	47.04	7.84
7	577	206	237	Idle	—	12.84	.07	12.91	6.67	4.66	5.51	—
8	1312	904	1031	1600	143	34.10	.95	35.05	8.00	59.29	83.10	11.44
9	1450	191	877	"	107	34.10	.73	34.83	53.53	14.00	70.41	8.56
10	1487	176	535	"	71.5	34.20	.55	34.75	53.21	12.87	41.94	5.72
11	1588	221	317	"	36	34.30	.38	34.68	58.15	16.15	24.80	2.88
12	1654	221	304	"	—	34.10	.37	34.47	58.92	16.16	23.78	—
13	598	206	215	Idle	—	12.80	.07	12.87	6.78	4.65	5.40	—
								TOTALS	419.18	372.81	397.95	47.20

		RUN 1	RUN 2
gm C_6H_{14} = 0.0152 (ppm C_6H_{14})(Exh. Flow, lb/min)(Weight Factor)	BSHC, gm/bhp hr	9.53	8.85
gm CO = 0.0253 (ppm CO)(Exh. Flow, lb/min)(Weight Factor)	BSCO, gm/bhp hr	7.28	7.73
gm NO = 0.0782 (ppm NO)(Exh. Flow, lb/min)(Weight Factor)	BSNO, gm/bhp hr	8.37	8.25

TABLE D-4. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 9/11/70 Test Miles: 1073 Test Configuration: 60LSN + Cat. Muff.
Bus: 704 Test Hours: 98 Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/m C_6H_{14} (weighted)	g/m CO (weighted)	g/m NO (weighted)	OBSERVED bhp (weighted)
1	184	168	215	Idle	—●—	12.88	.07	12.95	2.10	9.92	5.24	—●—
2	196	192	166	1000	0	20.38	.15	20.53	4.25	8.30	7.67	—●—
3	196	143	278	"	24	20.37	.20	20.57	4.26	6.19	12.90	1.92
4	207	95	577	"	49	20.35	.34	20.69	4.52	4.14	26.94	3.92
5	217	119	882	"	74	20.30	.48	20.78	4.71	5.20	41.34	5.92
6	276	2022	1098	"	98	20.30	.68	20.98	6.11	89.26	51.97	7.84
7	138	168	215	Idle	—●—	12.88	.07	12.95	1.37	3.32	5.24	—●—
8	184	393	943	1600	146	33.58	.92	34.50	6.70	28.53	73.39	11.68
9	161	95	749	"	110	33.62	.75	34.37	5.84	6.97	58.08	8.80
10	173	71	493	"	73	33.68	.52	34.20	6.25	5.11	38.04	5.84
11	184	95	304	"	36	33.81	.34	34.15	6.63	6.82	23.42	2.88
12	184	95	357	"	—●—	33.90	.40	34.30	6.70	6.70	27.78	—●—
13	173	168	215	Idle	—●—	12.84	.07	12.91	1.37	3.30	5.22	—●—
								TOTALS	61.71	178.76	372.28	48.80

RUN 2

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/m C_6H_{14} (weighted)	g/m CO (weighted)	g/m NO (weighted)	OBSERVED bhp (weighted)
1	161	192	190	Idle	—●—	12.84	.07	12.91	1.73	4.35	4.62	—●—
2	173	192	202	1000	0	20.24	.17	20.41	3.73	8.25	7.50	—●—
3	184	168	330	"	24	20.24	.21	20.45	3.98	7.43	15.32	1.92
4	184	95	619	"	49	20.22	.34	20.56	3.99	4.11	28.91	3.92
5	184	119	928	"	74	20.20	.48	20.68	4.02	5.18	43.50	5.92
6	219	2398	1150	"	98	20.16	.68	20.84	4.82	104.70	55.13	7.84
7	127	143	240	Idle	—●—	12.84	.07	12.91	1.44	3.24	5.73	—●—
8	161	393	974	1600	146	33.52	.95	34.47	5.86	28.50	75.94	11.68
9	137	95	749	"	110	33.67	.72	34.39	5.01	6.97	58.11	8.80
10	150	71	493	"	73	33.91	.52	34.43	5.46	5.14	38.30	5.84
11	161	95	304	"	36	34.00	.33	34.33	5.84	6.96	23.54	2.88
12	173	95	357	"	—●—	34.11	.40	34.51	6.30	6.90	27.77	—●—
13	161	168	227	Idle	—●—	12.80	.07	12.87	1.73	3.30	5.50	—●—
								TOTALS	54.11	195.13	387.07	48.80

		RUN 1	RUN 2
g/m C_6H_{14} = 0.0152(ppm HC)(Exh. Flow, lb/min)(Weight Factor)	BSHC, g/bhp hr	1.66	1.10
g/m CO = 0.0165(ppm CO)(Exh. Flow, lb/min)(Weight Factor)	BSCO, g/bhp hr	3.66	3.99
g/m NO = 0.0782(ppm NO)(Exh. Flow, lb/min)(Weight Factor)	BSNO, g/bhp hr	7.75	7.97

TABLE D-5. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 9/16/70
Bus: 704

Test Miles: 1073
Test Hours: 98

Test Configuration: 60LSN + Stock Muff.
Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	$^{gm}/_{hr}$ C_6H_{14} (weighted)	$^{gm}/_{hr}$ CO (weighted)	$^{gm}/_{hr}$ NO (weighted)	OBSERVED bhp (weighted)
1	219	217	252	Idle	—0—	12.92	.07	12.99	1.83	2.94	6.15	—0—
2	230	266	190	1000	—0—	20.60	.14	20.74	5.09	11.61	8.89	—0—
3	184	119	438	"	24	20.58	.21	20.79	4.09	5.21	20.38	1.92
4	173	98	677	"	49	20.38	.35	20.73	3.82	4.18	31.99	3.92
5	209	172	1020	"	74	20.58	.48	21.06	4.60	8.80	49.46	5.92
6	286	3939	1051	"	98	20.45	.67	21.12	6.48	194.97	50.08	7.84
7	173	168	252	Idle	—0—	12.88	.07	12.95	2.64	3.28	6.14	—0—
8	196	477	1051	1600	146	34.10	.95	35.05	7.26	34.65	83.10	11.68
9	184	71	867	"	110	34.15	.72	34.87	6.78	5.41	68.21	8.80
10	173	71	591	"	73	34.20	.52	34.72	6.34	5.18	46.90	5.84
11	173	71	343	"	36	34.25	.35	34.60	6.32	5.17	26.78	
12	173	98	357	"	—0—	34.30	.41	34.71	6.34	7.64	27.75	—0—
13	173	167	252	Idle	—0—	12.84	.07	12.91	1.77	2.80	6.12	—0—
								TOTALS	63.40	278.90	420.67	48.80

RUN 2

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	$^{gm}/_{hr}$ C_6H_{14} (weighted)	$^{gm}/_{hr}$ CO (weighted)	$^{gm}/_{hr}$ NO (weighted)	OBSERVED bhp (weighted)
1	219	217	240	Idle	—0—	12.92	.07	12.99	1.83	4.94	5.26	—0—
2	230	266	190	1000	—0—	20.60	.15	20.75	5.09	11.62	8.90	—0—
3	184	143	399	"	24	20.58	.21	20.79	4.09	6.26	19.62	1.92
4	196	98	634	"	49	20.56	.35	20.91	4.33	4.18	29.91	3.92
5	219	143	994	"	74	20.50	.48	20.98	4.85	6.31	46.10	5.92
6	276	3876	1035	"	98	20.40	.67	21.07	6.14	169.66	49.80	7.84
7	207	192	240	Idle	—0—	12.88	.07	12.95	2.38	4.26	5.94	—0—
8	219	445	909	1600	146	34.10	.95	35.05	8.10	36.82	92.20	11.68
9	196	71	725	"	110	34.15	.72	34.87	7.22	5.41	64.74	8.80
10	196	71	599	"	73	34.20	.52	34.72	7.19	5.18	48.19	5.84
11	192	71	357	"	36	34.25	.35	34.60	7.16	5.17	27.26	2.88
12	196	99	357	"	—0—	34.30	.41	34.71	7.18	7.64	27.75	—0—
13	207	143	240	Idle	—0—	12.84	.07	12.91	2.35	3.24	5.82	—0—
								TOTALS	73.08	248.59	404.19	48.80

RUN 1 RUN 2

$^{gm}/_{hr}$ C_6H_{14} = 0.0152 (ppm C_6H_{14})(Exh. Flow, lb/min)(Weight Factor)   BSHC, g/bhp hr
$^{gm}/_{hr}$ CO = 0.0157 (ppm CO)(Exh. Flow, lb/min)(Weight Factor)   BSCO, g/bhp hr
$^{gm}/_{hr}$ NO = 0.0782 (ppm NO)(Exh. Flow, lb/min)(Weight Factor)   BSNO, g/bhp hr

TABLE D-6. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 9/18/70
Bus: 704

Test Miles: 1073
Test Hours: 98

Test Configuration: 608 + Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	921	217	166	Idle	—●—	12.90	.07	12.97	10.86	4.96	4.05	—●—
2	1558	296	163	1000	—●—	20.40	.15	20.55	29.47	10.68	6.63	—●—
3	1565	217	265	"	25	20.50	.25	20.75	34.24	9.46	16.38	2.00
4	1934	217	335	"	51	20.50	.37	20.87	42.62	9.53	25.19	4.08
5	1750	292	823	"	73	20.45	.52	20.97	38.75	12.98	32.94	5.84
6	1938	4343	928	"	102	20.43	.72	21.15	38.82	192.26	44.28	8.16
7	898	192	206	Idle	—●—	12.90	.07	12.97	10.18	4.34	4.89	—●—
8	1404	2678	994	1600	150	34.10	1.00	35.10	52.04	123.96	92.13	12.00
9	1485	169	619	"	102	34.10	.69	34.79	54.36	12.90	48.58	8.16
10	1466	168	481	"	75	34.16	.56	34.72	53.60	12.37	35.83	6.00
11	1669	192	317	"	38	34.16	.38	34.54	60.77	13.95	24.70	3.04
12	1508	192	298	"	—●—	34.18	.37	34.55	55.02	13.96	21.67	—●—
13	248	186	190	Idle	—●—	12.90	.07	12.97	2.48	4.24	4.40	—●—
								TOTALS	482.17	428.77	399.32	49.28

RUN 2

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	760	217	190	Idle	—●—	12.90	.07	12.97	8.61	4.90	4.60	—●—
2	1105	217	184	1000	—●—	20.40	.17	20.57	24.00	13.74	7.18	—●—
3	1420	217	342	"	25	20.50	.23	20.73	31.74	9.46	16.04	2.00
4	1599	217	535	"	51	20.50	.37	20.87	35.00	9.53	25.19	4.08
5	1490	393	852	"	73	20.45	.52	20.97	33.11	17.34	40.36	5.84
6	1450	4037	928	"	102	20.43	.72	21.15	32.38	177.65	44.28	8.16
7	725	192	202	Idle	—●—	12.90	.07	12.97	8.23	4.34	4.89	—●—
8	1243	1515	1038	1600	150	34.18	1.00	35.18	46.18	112.16	98.14	12.00
9	1312	143	590	"	102	34.10	.69	34.79	48.20	10.46	46.30	8.16
10	1301	143	479	"	75	34.16	.56	34.72	47.70	10.45	37.82	6.00
11	1480	168	343	"	38	34.20	.38	34.58	53.95	12.24	26.76	3.04
12	1490	192	304	"	—●—	34.28	.37	34.65	53.06	14.00	23.76	—●—
13	714	168	202	Idle	—●—	12.90	.07	12.97	8.01	3.80	4.89	—●—
								TOTALS	428.64	402.03	361.71	49.28

RUN 1   RUN 2

g/hr C_6H_{14} = 0.0152(ppm C_6H_{14})(EXH. FLOW, lb/min)(Weight Factor)   BSHC, g/bhp hr
g/hr CO = 0.0265(ppm CO)(EXH. FLOW, lb/min)(Weight Factor)   BSCO, g/bhp hr
g/hr NO = 0.0283(ppm NO)(EXH. FLOW, lb/min)(Weight Factor)   BSNO, g/bhp hr

TABLE D-7. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 8/28/70 Test Miles: 911 Test Configuration: 60LSN + Cat. Muff
Bus: 707 Test Hours: 99 Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	127	119	318	Idle	0	12.74	.08	12.82	1.65	2.67	5.22	0
2	115	119	252	1000	0	20.34	.13	20.47	2.49	5.13	11.64	0
3	127	71	479	"	26	20.33	.22	20.55	3.16	3.07	22.21	2.08
4	138	71	735	"	51	20.32	.35	20.67	3.02	3.09	34.27	4.08
5	184	217	1271	"	76	20.30	.50	20.85	3.75	9.29	58.67	6.08
6	161	3651	1163	"	101	20.30	.72	21.02	3.38	161.49	59.15	8.08
7	104	95	304	Idle	0	12.80	.08	12.88	1.18	2.15	7.36	0
8	72	605	1262	1600	156	33.75	1.00	34.75	3.38	44.09	98.94	12.48
9	72	71	1051	"	117	33.78	.77	34.55	3.36	5.16	81.92	9.36
10	92	47	706	"	78	33.81	.53	34.34	3.34	3.39	54.70	6.24
11	173	47	438	"	39	33.83	.33	34.16	6.06	3.38	33.75	3.12
12	115	71	438	"	0	33.85	.42	34.27	4.16	5.12	33.96	0
13	127	95	330	Idle	0	12.80	.08	12.88	1.64	2.15	8.00	0
								TOTALS	40.36	250.18	505.67	51.52

RUN 2

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	115	95	317	Idle	0	12.80	.08	12.88	1.51	2.15	7.68	0
2	138	119	252	1000	0	20.34	.13	20.47	2.98	5.11	11.62	0
3	150	71	385	"	26	20.33	.22	20.55	3.94	3.07	24.80	2.08
4	127	71	778	"	51	20.32	.35	20.67	3.19	3.07	36.28	4.08
5	164	192	1346	"	76	20.30	.50	20.80	3.78	8.22	61.77	6.08
6	140	3028	1229	"	101	20.30	.72	21.02	3.10	133.92	58.23	8.08
7	99	71	357	Idle	0	12.80	.08	12.88	1.10	1.61	8.65	0
8	81	550	1416	1600	156	33.75	1.00	34.75	2.99	40.22	111.02	12.48
9	78	71	1105	"	117	33.78	.77	34.55	2.83	5.16	90.12	9.36
10	115	47	798	"	78	33.81	.53	34.34	4.17	3.39	60.29	6.24
11					39	33.83	.33	34.16	6.24	3.38	33.75	3.12
12	161	71	451	"	0	33.85	.40	34.25	7.18	5.31	40.98	0
13	115	95	240	Idle	0	12.80	.08	12.88	1.51	2.15	5.82	0
								TOTALS	42.86	217.78	550.01	51.52

		RUN 1	RUN 2
g/hr C_6H_{14} = 0.0152 (ppm C_6H_{14})(exh. flow, lb/min)(Weight Factor)	BSHC, g/bhp hr	0.78	0.83
g/hr CO = 0.0165 (ppm CO)(exh. flow, lb/min)(Weight Factor)	BSCO, g/bhp hr	4.85	4.22
g/hr NO = 0.0782 (ppm NO)(exh. flow, lb/min)(Weight Factor)	BSNO, g/bhp hr	9.81	10.77

TABLE D-6. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 9/2/70 Test Miles: 911 Test Configuration: 60LSN + Stock Muff.
Bus: 707 Test Hours: 99 Fuel: EM-165-F (No. 1 Diesel)

RUN 1

Mode	C_6H_{14}, ppm	CO, ppm	NO, ppm	Engine Speed, rpm	Observed Power, bhp	Air Flow, lb/min	Fuel Flow, lb/min	Exhaust Flow, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	Observed bhp (weighted)
1	161	143	268	Idle	—0—	11.14	.08	12.72	1.83	3.24	6.44	—0—
2	173	143	266	1000	—0—	20.35	.13	20.48	3.74	6.16	11.07	—0—
3	173	95	438	"	26	20.34	.22	20.56	3.76	4.11	20.31	2.19
4	161	95	691	"	51	20.33	.34	20.67	3.51	4.13	33.66	4.08
5	184	118	1114	"	76	20.32	.51	20.83	4.05	6.44	52.35	6.08
6	230	4999	1166	"	101	20.30	.72	21.02	5.10	221.07	59.54	8.08
7	161	143	291	Idle	—0—	12.80	.08	12.88	1.83	3.63	7.05	—0—
8	184	967	1242	1600	156	33.76	1.00	34.76	6.35	46.10	98.77	12.48
9	150	95	1035	"	117	33.78	.77	34.55	5.47	6.90	70.67	9.76
10	138	71	605	"	78	33.82	.52	34.34	5.00	5.13	46.34	6.84
11	150	95	330	"	39	33.83	.33	34.16	5.41	6.82	32.43	3.16
12	150	71	424	"	—0—	33.86	.41	34.27	5.43	5.12	22.78	—0—
13	161	143	298	Idle	—0—	12.80	.08	12.88	1.83	3.63	6.74	—0—
								TOTALS	53.71	331.82	429.23	51.96

RUN 2

Mode	C_6H_{14}, ppm	CO, ppm	NO, ppm	Engine Speed, rpm	Observed Power, bhp	Air Flow, lb/min	Fuel Flow, lb/min	Exhaust Flow, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	Observed bhp (weighted)
1	161	167	228	Idle	—0—	12.84	.08	12.92	1.83	3.78	5.54	—0—
2	173	163	218	1000	—0—	20.31	.15	20.46	3.74	6.16	9.92	—0—
3	174	95	479	"	26	20.32	.23	20.55	3.75	4.10	22.21	2.08
4	173	91	677	"	51	20.30	.37	20.67	3.78	3.07	31.87	4.08
5	184	119	1116	"	76	20.30	.50	20.80	4.09	5.21	51.27	6.08
6	196	4948	1130	"	101	20.30	.72	21.02	4.35	218.87	53.58	8.08
7	150	143	291	Idle	—0—	12.81	.08	12.89	1.70	3.26	7.26	—0—
8	173	823	1070	1600	156	33.79	1.00	34.79	6.35	60.51	100.[illegible]	12.48
9	150	71	1067	"	117	33.78	.77	34.55	5.46	[illegible]	[illegible]	9.76
10	138	47	648	"	78	33.50	.52	34.02	5.00	3.37	50.18	6.24
11	138	71	387	"	39	33.82	.33	34.15	4.77	5.10	[illegible]	3.16
12	138	71	387	"	—0—	33.80	.40	34.20	4.77	5.11	27.78	—0—
13	150	119	240	Idle	—0—	12.80	.08	12.88	1.70	2.67	5.56	—0—
								TOTALS	51.66	[illegible]	[illegible]	[illegible]

		RUN 1	RUN 2
g/hr C_6H_{14} = 0.0152 (ppm C_6H_{14})(Exh. Flow, lb/min)(Weight Factor)	BSHC, g/bhp hr	1.04	1.05
g/hr CO = 0.0265 (ppm CO)(Exh. Flow, lb/min)(Weight Factor)	BSCO, g/bhp hr	3.88	4.56
g/hr NO = 0.0782 (ppm NO)(Exh. Flow, lb/min)(Weight Factor)	BSNO, g/bhp hr	7.06	7.77

TABLE D-9. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 9/4/70　　Test Miles: 911　　Test Configuration: 608 + Stock Muffler
Bus: 707　　Test Hours: 99　　Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	W_t C_6H_{14} (weighted)	W_t CO (weighted)	W_t NO (weighted)	OBSERVED bhp (weighted)
1	760	168	178	Idle	—●—	12.88	.07	12.95	8.66	3.82	4.34	—●—
2	1013	168	178	1000	—●—	20.38	.13	20.51	21.90	7.25	8.34	—●—
3	1773	163	451	"	26	20.37	.23	20.60	28.57	6.30	20.46	2.08
4	1565	163	648	"	52	20.54	.37	20.91	34.22	6.23	30.27	4.16
5	1519	242	994	"	78	20.28	.53	20.81	32.96	10.46	45.15	6.24
6	1727	3838	1100	"	103	20.16	.73	20.89	38.10	165.80	51.84	8.24
7	760	143	345	Idle	—●—	12.84	.07	12.91	8.64	3.04	5.28	—●—
8	1427	1174	1179	1600	157	32.76	1.06	33.82	30.96	83.40	87.96	12.56
9	1404	143	898	"	117	33.16	.80	33.96	30.20	10.19	68.60	9.36
10	1289	119	599	"	78	33.82	.55	34.37	47.78	8.61	44.78	6.24
11	1588	143	317	"	39	33.83	.38	34.21	57.37	10.29	24.47	3.12
12	1657	143	357	"	—●—	33.86	.42	34.28	57.98	10.31	27.61	—●—
13	737	143	306	Idle	—●—	12.84	.07	12.91	8.41	3.05	4.73	—●—
								TOTALS				

RUN 2

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	W_t C_6H_{14} (weighted)	W_t CO (weighted)	W_t NO (weighted)	OBSERVED bhp (weighted)
1	691	168	116	Idle	—●—	12.84	.08	12.92	7.86	3.81	4.04	—●—
2	944	168	166	1000	—●—	20.83	.15	20.98	20.42	7.84	9.67	—●—
3	1291	163	451	"	26	20.35	.25	20.60	29.86	6.16	20.34	2.08
4	1406	143	648	"	52	20.23	.38	20.61	30.06	6.20	30.13	4.16
5	1381	172	1035	"	78	20.11	.51	20.61	30.06	8.33	48.15	6.24
6	1450	3741	1163	"	103	20.14	.72	20.86	31.98	168.57	54.73	8.24
7	668	143	215	Idle	—●—	12.80	.05	12.85	7.59	3.23	5.21	—●—
8	1259	1073	1238	1600	157	32.77	1.03	34.10	47.69	77.10	96.41	12.56
9	1174	143	965	"	117	33.35	.80	34.15	41.67	10.40	67.42	9.36
10	1105	119	591	"	78	33.50	.57	34.07	40.11	8.61	45.33	6.24
11	1404	143	317	"	39	33.82	.38	34.20	50.71	10.29	24.46	3.12
12	1427	143	330	"	—●—	33.83	.42	34.25	50.64	10.31	25.61	—●—
13	685	143	215	Idle	—●—	12.80	.08	12.88	7.35	3.26	5.11	—●—
								TOTALS	399.43	325.53	438.68	52.00

		RUN 1	RUN 2
W_t C_6H_{14} = 0.0152(ppm C_6H_{14})(EXH. FLOW, lb/min)(Weight Factor)	BSHC, g/bhp hr	8.70	7.68
W_t CO = 0.0153(ppm CO)(EXH. FLOW, lb/min)(Weight Factor)	BSCO, g/bhp hr	6.12	6.26
W_t NO = 0.0782(ppm NO)(EXH. FLOW, lb/min)(Weight Factor)	BSNO, g/bhp hr	8.11	8.43

TABLE D-10. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 4/26/71 Test Miles: 22,962 Test Configuration: 60LSN + Cat. Muff.
Bus: 702 Test Hours: 1721 Fuel: EM-165-F (No. 1 Diesel)

RUN 1

Mode	C_6H_{14}, ppm	CO, ppm	NO, ppm	Engine Speed, rpm	Observed Power, bhp	Air Flow, lb/min	Fuel Flow, lb/min	Exhaust Flow, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	Observed bhp (weighted)
1	180	182	145	Idle	—0—	12.84	.06	12.90	1.71	2.06	3.30	—0—
2	170	165	166	1000	—0—	20.35	.13	20.48	3.24	4.11	4.15	—0—
3	163	88	326	"	21	20.36	.19	20.55	3.54	3.80	14.10	1.68
4	188	63	478	"	47	20.38	.34	20.72	4.11	2.95	20.91	3.76
5	237	216	771	"	72	20.29	.47	20.76	5.24	9.48	33.84	5.76
6	237	2,294	970	"	70	20.30	.60	20.90	5.25	100.12	35.26	9.20
7	170	139	176	Idle	—0—	12.80	.05	12.85	1.70	3.15	3.77	—0—
8	200	371	813	1600	136	33.83	.81	34.64	7.31	26.16	59.25	10.88
9	170	80	625	"	94	33.55	.63	34.18	5.41	3.60	44.35	7.52
10	150	38	440	"	61	[illegible]	.46	34.29	5.43	1.50	31.74	4.71
11	150	38	303	"	30	34.10	.31	34.41	5.45	3.75	21.94	2.40
12	150	38	314	"	—0—	34.10	.33	34.43	5.45	2.75	22.75	—0—
13	163	88	176	Idle	—0—	12.80	.03	12.83	1.55	1.97	4.21	—0—
								TOTALS	55.67	167.93	316.17	42.82

RUN 2

Mode	C_6H_{14}, ppm	CO, ppm	NO, ppm	Engine Speed, rpm	Observed Power, bhp	Air Flow, lb/min	Fuel Flow, lb/min	Exhaust Flow, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	Observed bhp (weighted)
1	180	137	145	Idle	—0—	12.80	.06	12.86	1.71	3.18	3.27	—0—
2	170	165	196	1000	—0—	20.30	.13	20.43	3.24	4.07	4.57	—0—
3	170	101	348	"	24	20.31	.20	20.51	2.77	4.26	15.02	1.72
4	180	95	477	"	47	20.32	.33	20.65	4.10	3.82	21.45	3.44
5	238	227	741	"	75	20.35	.47	20.82	5.23	16.03	36.84	6.00
6	238	2444	887	"	90	20.38	.60	20.98	5.26	109.19	37.69	9.22
7	163	114	176	Idle	—0—	12.80	.05	12.85	1.55	5.35	4.21	—0—
8	200	375	813	1600	124	33.83	.80	34.63	7.31	27.18	59.24	[illegible]
9	150	67	601	"	93	33.55	.62	34.17	5.41	4.55	46.80	7.44
10	150	35	464	"	61	33.83	.45	34.28	5.43	2.74	33.47	4.53
11	150	67	314	"	30	34.10	.31	34.41	5.45	4.56	22.75	2.41
12	150	50	314	"	—0—	34.10	.33	34.43	5.45	3.67	22.75	—0—
13	163	126	176	Idle	—0—	12.80	.03	12.83	1.55	2.85	3.98	—0—
								TOTALS	56.08	188.86	317.21	[illegible]

		RUN 1	RUN 2
g/hr C_6H_{14} = 0.0152(ppm C_6H_{14})(Exh. Flow, lb/min)(Weight Factor)	BSHC, g/bhp hr	1.28	1.29
g/hr CO = 0.0265(ppm CO)(Exh. Flow, lb/min)(Weight Factor)	BSCO, g/bhp hr	3.88	4.36
g/hr NO = 0.0782(ppm NO)(Exh. Flow, lb/min)(Weight Factor)	BSNO, g/bhp hr	7.04	7.27

TABLE D-11. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 4/29/71 Test Miles: 22,962 Test Configuration: 601SN + St.-b Muff.
Bus: 702 Test Hours: 1721 Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	180	137	135	Idle	— 0 —	12.88	.05	12.93	1.77	3.17	3.30	— 0 —
2	138	165	186	1000	— 0 —	20.35	.10	20.45	2.98	4.10	4.20	— 0 —
3	125	76	314	"	22	20.15	.20	20.35	2.71	3.29	14.96	1.76
4	138	80	478	"	44	20.16	.31	20.47	3.01	2.17	27.15	3.52
5	200	168	771	"	73	20.11	.48	20.59	4.41	7.28	36.20	5.14
6	200	2113	886	"	90	20.15	.60	20.75	4.45	98.14	40.46	7.20
7	180	114	186	Idle	— 0 —	12.14	.05	12.19	1.11	2.59	2.80	— 0 —
8	175	346	730	1600	136	34.10	.88	34.98	6.49	25.49	57.67	10.88
9	180	25	689	"	98	34.10	.65	34.75	5.50	1.93	43.04	7.84
10	138	13	428	"	72	34.10	.51	34.61	5.04	0.96	33.42	5.76
11	165	15	271	"	36	34.10	.33	34.43	4.54	1.31	21.05	2.78
12	125	25	292	"	— 0 —	34.10	.36	34.46	[illegible]	1.32	22.77	— 0 —
13	180	101	156	Idle	— 0 —	12.30	.05	12.35	1.70	2.17	2.79	— 0 —
								TOTALS	48.27	152.96	309.51	[illegible]

RUN 2

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	184	139	135	Idle	— 0 —	12.94	.05	12.99	2.14	3.16	3.27	— 0 —
2	185	165	145	1000	— 0 —	20.10	.10	20.20	4.06	4.09	6.67	— 0 —
3	163	88	348	"	22	20.30	.20	20.50	3.53	2.40	16.09	1.76
4	175	80	512	"	44	20.32	.31	20.63	3.91	1.17	23.53	3.52
5	213	190	788	"	73	20.53	.48	21.01	4.68	8.92	55.07	5.84
6	235	2178	899	"	90	20.38	.60	20.98	4.97	98.91	42.45	[illegible]
7	188	114	166	Idle	— 0 —	12.90	.05	12.95	2.14	2.58	4.03	— 0 —
8	225	373	785	1600	136	34.10	.88	34.98	9.31	17.45	61.95	[illegible]
9	175	33	596	"	98	34.10	.65	34.75	6.42	2.19	46.74	7.84
10	180	25	448	"	72	34.10	.51	34.61	5.91	1.82	34.36	5.76
11	150	39	392	"	31	34.20	.36	34.56	5.47	2.16	33.77	[illegible]
12	180	25	314	"	— 0 —	34.20	.36	34.56	5.19	1.91	24.50	— 0 —
13	175	88	166	Idle	— 0 —	12.50	.05	12.55	1.99	1.99	4.05	— 0 —
								TOTALS	58.47	161.63	325.58	[illegible]

		RUN 1	RUN 2
g/hr C_6H_{14} = 0.0152 (ppm C_6H_{14})(EXH. FLOW, lb/min)(Weight Factor)	BSHC, g/bhp hr	1.07	1.27
g/hr CO = 0.0165 (ppm CO)(EXH. FLOW, lb/min)(Weight Factor)	BSCO, g/bhp hr	3.36	3.51
g/hr NO = 0.0182 (ppm NO)(EXH. FLOW, lb/min)(Weight Factor)	BSNO, g/bhp hr	6.80	7.06

TABLE D-12. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 4/30/71
Bus: 702

Test Miles: 22,962
Test Hours: 1721

Test Configuration: 608 + Stock Muffler
Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_7H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_7H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	1012	190	145	Idle	0	12.80	.06	12.86	11.92	4.31	3.22	0
2	1370	229	186	1000	0	20.30	.14	20.44	29.69	9.95	8.00	0
3	2399	199	326	"	21	20.32	.20	20.52	51.46	7.69	14.07	1.68
4	2900	176	500	"	47	20.34	.35	20.69	63.56	6.62	21.77	3.72
5	2625	331	799	"	69	20.35	.47	20.82	55.59	12.31	35.00	5.52
6	2225	3603	899	"	97	20.30	.67	20.97	49.37	158.97	39.66	7.76
7	950	156	166	Idle	0	12.80	.05	12.85	10.90	3.44	2.76	0
8	1930	465	944	1600	145	34.10	.97	35.07	73.36	34.53	69.67	11.60
9	2275	174	717	"	106	34.12	.72	34.84	83.70	8.36	52.56	8.48
10	2275	161	500	"	73	34.00	.55	34.55	83.00	7.34	36.55	5.84
11	2650	139	303	"	38	34.00	.38	34.38	96.21	10.05	21.92	3.04
12	2800	189	326	"	0	34.00	.40	34.40	101.71	10.84	23.60	0
13	950	139	176	Idle	0	12.80	.05	12.85	10.12	3.15	3.97	0
								TOTALS	716.41	296.48	333.77	47.59

RUN 2

MODE	C_7H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_7H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	900	178	135	Idle	0	12.80	.06	12.86	10.50	4.03	3.06	0
2	1025	216	66	1000	0	20.32	.12	20.44	21.79	9.29	7.19	0
3	2390	165	310	"	24	20.32	.22	20.54	51.41	9.13	13.89	1.92
4	2900	152	487	"	48	20.13	.35	20.48	63.33	6.61	21.19	3.[illegible]
5	2350	265	715	"	73	20.32	.50	20.82	52.22	11.74	34.37	5.[illegible]
6	2165	3427	899	"	97	20.33	.66	20.99	49.91	151.35	39.70	7.76
7	950	190	166	Idle	0	12.80	.05	12.85	10.80	4.30	2.76	0
8	1900	465	914	1600	145	34.12	.97	35.09	70.40	34.53	67.48	11.[illegible]
9	2165	186	703	"	106	34.10	.72	34.82	79.68	9.24	51.48	8.48
10	2225	161	475	"	73	34.10	.54	34.64	81.39	7.36	34.62	5.[illegible]
11	2575	139	292	"	35	34.10	.36	34.46	93.70	10.08	21.17	[illegible]
12	2750	186	303	"	0	34.10	.38	34.48	100.15	9.14	11.94	0
13	900	136	156	Idle	0	12.80	.05	12.85	10.13	2.95	3.53	0
								TOTALS	708.98	287.48	327.14	4[illegible]

		RUN 1	RUN 2
g/hr C_7H_{14} = 0.0152 (ppm C_7H_{14})(Exh. Flow, lb/min)(Weight Factor)	BSHC, g/bhp hr	14.90	14.64
g/hr CO = 0.0163 (ppm CO)(Exh. Flow, lb/min)(Weight Factor)	BSCO, g/bhp hr	5.75	5.87
g/hr NO = 0.0782 (ppm NO)(Exh. Flow, lb/min)(Weight Factor)	BSNO, g/bhp hr	6.74	6.73

TABLE D-13. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 4/12/71　　Test Miles: 28,193　　Test Configuration: 6013N + Cat. Muff.
Bus: 704　　Test Hours: 3063　　Fuel: EM-165-F (No. 1 Diesel)

RUN 1

Mode	C_6H_{14}, ppm	CO, ppm	NO, ppm	Engine Speed, rpm	Observed Power, bhp	Air Flow, lb/min	Fuel Flow, lb/min	Exhaust Flow, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO_2 (weighted)	Observed bhp (weighted)
1	325	203	176	Idle	—	12.86	.05	12.91	2.57	4.62	6.29	—
2	250	177	196	1000	—	20.18	.13	20.31	5.41	7.63	8.57	—
3	275	126	348	"	25	20.35	.22	20.57	7.98	5.46	16.16	2.00
4	300	113	541	"	49	20.36	.33	20.69	6.55	4.92	26.17	3.94
5	362	268	989	"	78	20.37	.52	20.89	7.99	11.78	42.98	6.24
6	387	3485	886	"	91	20.35	.65	21.00	8.58	152.98	40.55	7.28
7	225	165	196	Idle	—	12.86	.07	12.93	2.57	3.76	4.79	—
8	325	348	943	1600	141	33.37	.90	34.27	11.77	37.32	72.78	11.28
9	262	101	771	"	110	33.37	.72	34.09	7.93	7.84	57.20	8.80
10	225	63	536	"	73	33.65	.52	34.17	7.12	4.35	41.42	5.84
11	200	63	347	"	38	33.65	.35	34.00	6.19	4.81	26.63	2.94
12	200	75	349	"	—	33.64	.35	33.99	6.18	5.36	26.61	—
13	187	126	217	Idle	—	12.87	.07	12.94	2.19	2.97	3.31	—
								TOTALS	85.47	255.97	376.36	47.32

RUN 2

Mode	C_6H_{14}, ppm	CO, ppm	NO, ppm	Engine Speed, rpm	Observed Power, bhp	Air Flow, lb/min	Fuel Flow, lb/min	Exhaust Flow, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO_2 (weighted)	Observed bhp (weighted)
1	175	203	176	Idle	—	12.86	.07	12.93	2.00	4.63	4.30	—
2	200	203	196	1000	—	20.18	.13	20.31	3.62	7.75	7.87	—
3	225	126	393	"	25	20.36	.22	20.58	4.89	5.16	17.25	2.00
4	250	113	576	"	51	20.36	.35	20.71	5.47	4.92	27.38	4.08
5	300	333	981	"	78	20.37	.52	20.89	6.62	14.64	46.61	6.24
6	275	3712	914	"	91	20.35	.65	21.00	6.10	146.34	43.50	7.28
7	150	177	207	Idle	—	12.86	.05	12.91	1.71	4.03	5.05	—
8	250	532	943	1600	138	33.37	.90	34.27	9.05	39.36	72.91	11.04
9	225	113	777	"	110	33.37	.72	34.09	8.10	9.11	61.45	8.80
10	200	75	536	"	73	33.65	.54	34.19	7.22	5.59	41.32	5.84
11	175	101	347	"	38	33.65	.35	34.00	6.28	7.23	26.69	3.04
12	175	88	347	"	—	33.64	.35	33.99	6.28	6.29	26.69	—
13	175	151	217	Idle	—	12.87	.07	12.94	2.00	3.44	3.31	—
								TOTALS	69.34	252.79	387.83	48.33

		RUN 1	RUN 2
g/hr C_6H_{14} = 0.0152 (ppm C_6H_{14})(Exh. Flow, lb/min)(Weight Factor)	BSHC, g/bhp hr	1.77	1.44
g/hr CO = 0.0263 (ppm CO)(Exh. Flow, lb/min)(Weight Factor)	BSCO, g/bhp hr	5.30	5.23
g/hr NO_2 = 0.0782 (ppm NO)(Exh. Flow, lb/min)(Weight Factor)	BSNO, g/bhp hr	7.79	8.03

TABLE D-14. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 4/15/71 Test Miles: 25,193 Test Configuration: 60LSN + Stock Muff.
Bus: 704 Test Hours: 2063 Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	238	178	176	Idle	—0—	12.92	.05	12.97	3.26	4.07	4.31	—0—
2	213	178	176	1000	—0—	20.41	.15	20.56	4.62	9.90	7.63	—0—
3	200	76	428	"	27	20.42	.17	20.59	4.35	3.89	19.32	2.38
4	213	63	596	"	51	20.43	.17	20.60	4.63	2.73	27.13	4.08
5	250	255	1035	"	77	20.44	.18	20.62	5.44	11.06	48.15	6.32
6	338	3255	927	"	98	20.41	.22	20.63	7.36	141.23	42.14	7.84
7	250	139	197	Idle	—0—	12.92	.05	12.97	2.57	3.18	9.83	—0—
8	288	465	974	1600	160	33.92	.57	34.49	10.49	33.74	76.79	11.30
9	238	38	777	"	116	33.65	.58	34.23	8.60	2.94	61.70	9.27
10	213	25	596	"	75	33.92	.53	34.45	7.75	1.81	41.66	6.00
11	200	38	326	"	42	33.92	.48	34.40	7.27	2.75	25.30	3.36
12	188	38	303	"	—0—	33.92	.43	34.35	6.81	2.75	23.48	—0—
13	213	126	176	Idle	—0—	12.89	.05	12.94	2.44	2.77	4.30	—0—
								TOTALS	95.29	219.98	388.80	52.40

RUN 2

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	200	178	166	Idle	—0—	12.92	.05	12.97	2.29	4.07	4.07	—0—
2	200	190	176	1000	—0—	20.41	.15	20.56	4.34	5.29	7.16	—0—
3	200	88	313	"	25	20.42	.17	20.59	4.35	3.81	17.26	2.20
4	200	76	625	"	53	20.43	.18	20.61	4.35	3.30	29.06	2.64
5	250	255	1020	"	80	20.44	.22	20.66	5.45	11.08	47.84	6.40
6	288	3496	929	"	97	20.41	.23	20.64	6.28	151.37	43.26	7.76
7	213	139	176	Idle	—0—	12.92	.05	12.97	2.44	3.18	4.31	—0—
8	250	819	977	1600	161	33.92	.55	34.47	9.11	39.66	75.95	11.29
9	225	30	890	"	116	33.92	.57	34.49	8.19	2.63	67.17	9.28
10	200	13	869	"	98	33.94	.52	34.46	7.28	.94	41.67	6.24
11	175	38	357	"	41	33.92	.45	34.37	6.35	2.75	26.12	3.29
12	175	38	314	"	—0—	33.92	.43	34.35	6.35	2.75	24.33	—0—
13	188	139	176	Idle	—0—	12.86	.05	12.91	2.15	3.16	4.29	—0—
								TOTALS	71.80	235.94	396.73	47.18

		RUN 1	RUN 2
g/hr C_6H_{14} = 0.0152 (ppm C_6H_{14})(EXH. FLOW, lb/min)(Weight Factor)	BSHC, g/bhp hr	1.81	1.47
g/hr CO = 0.0263 (ppm CO)(EXH. FLOW, lb/min)(Weight Factor)	BSCO, g/bhp hr	4.36	4.83
g/hr NO = 0.0782 (ppm NO)(EXH. FLOW, lb/min)(Weight Factor)	BSNO, g/bhp hr	7.71	8.11

TABLE D-15. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 4/16/71　　Test Miles: 25,193　　Test Configuration: 608 + Stock Muffler
Bus: 704　　Test Hours: 2063　　Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_xH_y, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_xH_y (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	1012	255	125	Idle	—0—	12.95	.05	13.00	11.64	8.84	3.07	—0—
2	1438	333	86	1000	—0—	20.44	.15	20.59	51.27	14.43	3.99	—0—
3	1950	190	314	"	30	20.45	.19	20.64	42.46	8.24	14.61	2.40
4	2500	152	512	"	57	20.46	.18	20.64	54.49	6.00	25.34	4.56
5	2175	340	727	"	81	20.47	.22	20.69	47.52	13.93	37.60	6.48
6	2150	4210	884	"	101	20.48	.25	20.73	47.07	173.62	40.03	8.08
7	900	190	156	Idle	—0—	12.95	.05	13.00	10.38	4.36	3.83	—0—
8	1995	1263	944	1600	157	33.67	.64	34.31	64.31	91.17	73.07	12.56
9	1962	101	703	"	110	33.69	.58	34.27	71.00	7.23	54.38	8.80
10	1930	96	487	"	81	33.98	.53	34.51	70.62	8.52	37.92	6.48
11	2162	126	292	"	46	33.98	.47	34.45	78.65	9.13	23.69	3.68
12	2125	126	282	"	—0—	33.97	.43	34.40	77.19	9.12	21.89	—0—
13	880	177	176	Idle	—0—	12.95	.05	13.00	8.77	4.08	4.32	—0—
								TOTALS	616.34	358.67	342.21	53.04

RUN 2

MODE	C_xH_y, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_xH_y (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	880	259	132	Idle	—0—	12.95	.05	13.00	9.97	8.84	3.96	—0—
2	1575	307	176	1000	—0—	20.44	.15	20.59	29.90	13.30	8.18	—0—
3	1975	203	326	"	30	20.45	.17	20.62	43.01	9.81	15.17	2.40
4	2425	165	536	"	57	20.46	.18	20.64	52.90	7.17	24.96	4.56
5	2125	356	870	"	81	20.47	.22	20.69	46.45	16.80	40.61	6.48
6	2050	4210	888	"	101	20.48	.23	20.71	44.93	173.45	41.35	8.08
7	825	205	156	Idle	—0—	12.95	.05	13.00	9.47	4.65	3.83	—0—
8	1995	1366	974	1600	157	33.67	.60	34.27	64.84	99.49	75.30	12.56
9	1925	126	730	"	116	33.69	.58	34.25	67.62	7.08	56.41	9.28
10	1925	88	512	"	81	33.94	.53	34.47	70.07	6.38	37.92	6.48
11	2175	155	303	"	46	33.94	.47	34.41	77.83	11.00	23.82	3.68
12	2150	155	303	"	—0—	33.96	.43	34.39	78.07	11.00	23.57	—0—
13	880	178	176	Idle	—0—	12.95	.05	13.00	7.77	4.08	4.32	—0—
								TOTALS	637.48	382.08	360.30	53.52

		RUN 1	RUN 2
g/hr C_xH_y = 0.0132 (ppm C_xH_y)(EXH. FLOW, lb/min)(Weight Factor)	BSHC, g/bhp hr	11.62	11.91
g/hr CO = 0.0265 (ppm CO)(EXH. FLOW, lb/min)(Weight Factor)	BSCO, g/bhp hr	6.73	7.14
g/hr NO = 0.0782 (ppm NO)(EXH. FLOW, lb/min)(Weight Factor)	BSNO, g/bhp hr	6.45	6.77

TABLE D-16. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 3/29/71 Test Miles: 26,650 Test Configuration: 6V71N + Cat. Muff.
Bus: 707 Test Hours: 1971 Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	188	137	218	Idle	0	12.89	.06	12.95	2.15	3.17	5.52	0
2	188	114	207	1000	0	20.35	.11	20.46	4.06	4.31	9.88	0
3	212	76	384	"	32	20.34	.25	20.59	4.61	2.57	17.94	2.56
4	212	76	612	"	60	20.33	.40	20.73	4.64	3.11	27.68	4.80
5	250	239	990	"	71	20.32	.46	20.78	5.49	10.01	40.77	5.68
6	275	4996	906	"	105	20.30	.70	21.00	6.10	220.31	40.83	8.40
7	138	114	228	Idle	0	12.86	.05	12.91	1.88	3.09	5.86	0
8	200	1183	1004	1600	146	33.76	.98	34.74	7.34	80.60	79.66	11.68
9	175	101	870	"	112	33.76	.73	34.49	6.37	7.33	67.69	8.96
10	162	89	561	"	72	33.78	.51	34.29	5.85	2.74	43.37	5.76
11	150	55	393	"	41	33.89	.36	34.25	5.43	1.80	30.37	3.28
12	138	55	389	"	0	33.76	.33	34.09	4.77	1.79	27.61	0
13	175	76	228	Idle	0	12.88	.03	12.91	2.00	1.73	5.76	0
								TOTALS	60.70	342.56	401.40	51.12

RUN 2

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	g/hr C_6H_{14} (weighted)	g/hr CO (weighted)	g/hr NO (weighted)	OBSERVED bhp (weighted)
1	163	126	197	Idle	0	12.94	.05	12.99	2.22	2.88	4.73	0
2	163	126	217	1000	0	20.38	.11	20.49	3.51	5.03	10.08	0
3	175	101	405	"	35	20.40	.26	20.66	3.82	4.37	18.88	2.80
4	200	101	664	"	54	20.41	.36	20.77	4.38	4.41	31.08	4.32
5	225	239	774	"	73	20.31	.45	20.76	4.96	10.45	45.44	5.84
6	262	4953	944	"	105	20.37	.70	21.07	5.71	218.14	44.97	8.40
7	138	139	249	Idle	0	12.93	.05	12.98	1.57	3.15	6.06	0
8	175	888	1099	1600	146	33.76	.96	34.72	6.42	73.20	96.83	11.68
9	162	114	914	"	112	33.76	.73	34.49	5.90	5.27	71.12	8.96
10	138	76	679	"	72	33.78	.51	34.29	4.97	3.48	46.31	5.76
11	138	63	393	"	41	33.89	.36	34.25	4.97	4.84	30.37	3.28
12	150	76	389	"	0	33.76	.33	34.09	4.77	5.45	27.61	0
13	175	126	249	Idle	0	12.86	.05	12.91	2.00	2.87	6.07	0
								TOTALS	55.26	344.26	429.15	51.04

		RUN 1	RUN 2
g/hr C_6H_{14} = 0.0132 (ppm C_6H_{14})(Exh. Flow, lb/min)(Weight Factor)	BSHC, g/bhp hr	1.19	1.08
g/hr CO = 0.0263 (ppm CO)(Exh. Flow, lb/min)(Weight Factor)	BSCO, g/bhp hr	6.70	6.74
g/hr NO = 0.0282 (ppm NO)(Exh. Flow, lb/min)(Weight Factor)	BSNO, g/bhp hr	7.85	8.40

TABLE D-17. 13-MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 4/1/71 Test Miles: 26,650 Test Configuration: 60LSN + Stock Muff.
Bus: 707 Test Hours: 1971 Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	gm C_6H_{14} (weighted)	gm CO (weighted)	gm NO (weighted)	OBSERVED bhp (weighted)
1	200	139	156	Idle	—	12.98	.05	13.03	2.30	3.19	3.94	—
2	199	139	186	1600	—	20.52	.30	20.82	4.15	6.09	7.74	—
3	199	88	390	"	22	20.50	.20	20.70	4.11	3.83	17.27	1.76
4	200	88	628	"	60	20.48	.40	20.88	4.41	3.87	29.44	4.80
5	237	320	917	"	76	20.45	.50	20.95	5.24	14.11	44.49	6.09
6	272	4989	841	"	100	20.45	.69	21.11	6.15	213.62	40.05	8.00
7	200	113	199	Idle	—	12.98	.05	13.03	2.30	2.59	4.85	—
8	225	1068	1004	1600	146	33.80	.95	34.75	7.26	76.40	75.71	11.68
9	200	76	881	"	110	33.92	.72	34.64	7.32	5.54	65.72	8.80
10	190	38	574	"	81	34.04	.57	34.61	6.40	2.77	44.92	6.49
11	165	38	349	"	41	34.15	.37	34.52	5.51	2.76	27.10	3.28
12	162	30	326	"	—	34.22	.35	34.57	5.91	2.64	25.42	—
13	216	101	207	Idle	—	12.98	.05	13.03	2.49	2.32	5.10	—
								TOTALS	64.96	339.73	392.86	66.33

RUN 2

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	gm C_6H_{14} (weighted)	gm CO (weighted)	gm NO (weighted)	OBSERVED bhp (weighted)
1	214	99	176	Idle	—	12.98	.07	13.05	2.48	3.02	4.34	—
2	199	101	207	1600	—	20.52	.32	20.84	4.14	4.43	9.93	—
3	162	60	393	"	26	20.50	.22	20.72	3.54	2.18	19.37	2.08
4	162	60	612	"	56	20.48	.37	20.85	3.57	2.19	29.97	4.32
5	222	316	899	"	80	20.45	.53	20.98	4.98	17.04	42.85	6.40
6	237	4912	890	"	99	20.43	.67	21.10	5.28	269.77	41.41	7.94
7	199	94	207	Idle	—	12.98	.05	13.03	2.17	2.02	5.10	—
8	212	933	1004	1600	141	33.80	.92	34.72	7.79	60.98	78.64	11.28
9	189	40	837	"	107	33.93	.70	34.63	6.87	2.64	64.59	8.56
10	195	25	574	"	75	34.04	.53	34.57	6.39	1.82	44.77	6.00
11	162	25	390	"	38	34.15	.35	34.50	5.90	1.81	28.80	3.04
12	150	38	348	"	—	34.22	.35	34.57	5.48	2.76	27.14	—
13	200	63	218	Idle	—	12.98	.05	13.03	2.30	1.45	5.37	—
								TOTALS	60.84	305.98	377.60	[illegible]

		RUN 1	RUN 2
gm C_6H_{14} = 0.0152(ppm C_6H_{14})(Exh. Flow, lb/min)(Weight Factor)	BSHC, g/bhp hr	1.27	1.22
gm CO = 0.0263(ppm CO)(Exh. Flow, lb/min)(Weight Factor)	BSCO, g/bhp hr	6.67	6.17
gm NO = 0.0782(ppm NO)(Exh. Flow, lb/min)(Weight Factor)	BSNO, g/bhp hr	7.73	7.06

TABLE D-18. 13 MODE CYCLE EMISSIONS - EIP FLEET TEST

Date: 4/3/71 Test Miles: 26,650 Test Configuration: 608 + Stock Muffler
Bus: 707 Test Hours: 1971 Fuel: EM-165-F (No. 1 Diesel)

RUN 1

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	gm C_6H_{14} (weighted)	gm CO (weighted)	gm NO (weighted)	OBSERVED bhp (weighted)
1	738	190	166	Idle	—	12.98	.05	13.00	9.63	4.35	4.07	—
2	1435	203	197	1000	—	20.48	.12	20.60	26.65	7.90	9.16	—
3	2000	178	393	"	32	20.43	.27	20.70	43.72	7.75	17.55	2.76
4	1720	190	577	"	53	20.43	.38	20.81	37.46	8.32	25.12	4.49
5	1800	333	885	"	77	20.43	.53	20.96	39.94	14.67	41.85	6.16
6	1850	3662	944	"	99	20.43	.68	21.11	41.34	162.65	44.96	7.76
7	875	178	186	Idle	—	12.95	.04	12.99	10.05	4.07	4.67	—
8	1675	1074	1066	1600	150	34.10	1.01	35.11	63.10	99.34	84.44	12.00
9	1700	182	914	"	115	34.10	.78	34.88	63.63	11.15	64.05	9.20
10	1725	119	599	"	83	34.10	.60	34.70	63.91	8.32	46.79	6.64
11	2100	139	348	"	40	34.10	.39	34.49	77.51	10.09	27.08	3.20
12	2125	139	348	"	—	34.10	.37	34.47	77.35	10.09	27.06	—
13	900	178	197	Idle	—	12.95	.03	12.98	10.35	4.07	4.83	—
								TOTALS	563.21	353.64	406.15	52.76

RUN 2

MODE	C_6H_{14}, ppm	CO, ppm	NO, ppm	ENGINE SPEED, rpm	OBSERVED POWER, bhp	AIR FLOW, lb/min	FUEL FLOW, lb/min	EXHAUST FLOW, lb/min	gm C_6H_{14} (weighted)	gm CO (weighted)	gm NO (weighted)	OBSERVED bhp (weighted)
1	875	201	166	Idle	—	12.95	.04	12.99	10.05	4.65	4.07	—
2	1400	203	199	1000	—	20.48	.15	20.63	27.63	8.91	9.17	—
3	2025	178	416	"	31	20.43	.26	20.69	44.24	7.75	19.42	2.48
4	1775	198	612	"	56	20.43	.40	20.83	39.04	7.80	27.76	4.48
5	1812	320	885	"	73	20.43	.50	20.93	40.05	14.09	41.77	5.88
6	1825	3722	974	"	99	20.43	.68	21.11	40.69	165.31	46.39	7.72
7	875	178	199	Idle	—	12.95	.04	12.99	10.05	4.04	4.74	—
8	1650	1131	1082	1600	153	34.10	1.03	35.13	61.51	93.60	85.75	12.24
9	1655	182	914	"	119	34.10	.81	34.91	62.25	11.16	71.97	9.52
10	1675	114	612	"	80	34.10	.58	34.68	61.34	8.32	47.87	6.40
11	2125	156	370	"	42	34.10	.40	34.50	77.48	9.15	28.70	3.36
12	2100	139	359	"	—	34.10	.35	34.45	76.40	10.09	27.90	—
13	875	165	197	Idle	—	12.95	.03	12.98	10.04	3.77	4.83	—
								TOTALS	547.73	337.56	421.15	52.24

		RUN 1	RUN 2
gm C_6H_{14} = 0.0152(ppm C_6H_{14})(EXH. FLOW, lb/min)(Weight Factor)	BSHC, gm/bhp hr	10.79	10.53
gm CO = 0.0265(ppm CO)(EXH. FLOW, lb/min)(Weight Factor)	BSCO, gm/bhp hr	6.41	6.48
gm NO = 0.0282(ppm NO)(EXH. FLOW, lb/min)(Weight Factor)	BSNO, gm/bhp hr	7.79	8.07